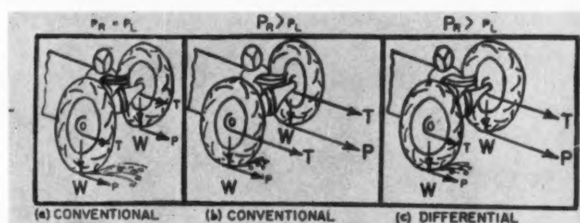
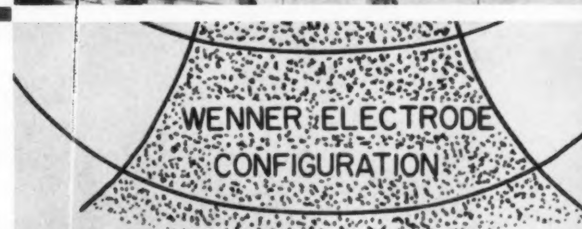
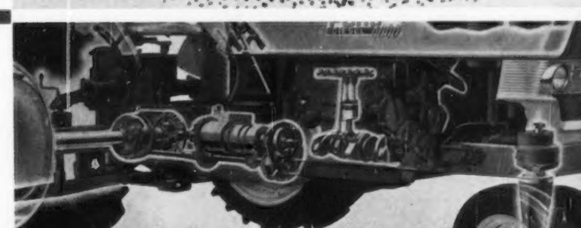
MARCH 1961

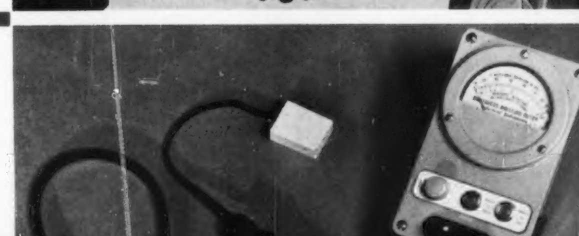
Agricultural Engineering

The Journal of the American Society of Agricultural Engineers









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Agricultural Engineering

Established 1920

CONTENTS • **MARCH, 1961** • **Vol. 42, No. 3**

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JAMES BASSELMAN, *Editor and Publisher*

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ASAE Now Full Member of EJC

MANY members of ASAE, it can be quite certain, have read with interest the announcement in the Winter, 1961, edition of the *Engineer*, official publication of Engineers Joint Council, to wit:

"The American Society of Agricultural Engineers has advanced in grade from National Associate to Constituent membership in EJC."

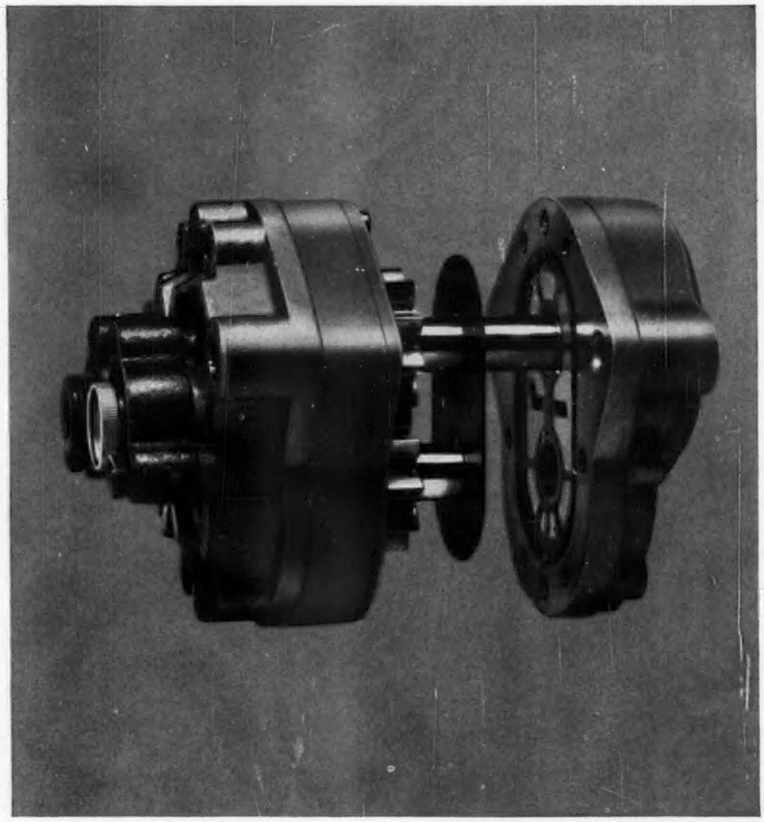
Since the advancement in membership grade is based on the society's increase in membership beyond the required 5,000 minimum, the announcement marked the fulfillment of another milestone in ASAE history. The goal of 5,000 voting members was reached at the closing of 1960 and application for constituent membership was made in response to action taken by the ASAE Council during the Winter Meeting in December. Early approval by the EJC Board of Directors made it possible to carry the announcement in the same issue as the address made by EJC's past-president, A. B. Kinzel. This report, entitled "Who Speaks for the Engineer?", illustrates how EJC attempts to coordinate the activities of the various engineering societies. See page 123.

In addition to added prestige for ASAE among other engineers, the new membership status naturally carries with it additional responsibilities to cooperate more actively in the aims and objectives of EJC on behalf of the over-all engineering profession. Constituent membership in EJC will permit ASAE to have representatives on a total of sixteen EJC committees, rather than the four in which they had been represented. The new committees and ASAE representatives are as follows: Constitution and Bylaws (O. C. French); Finance (G. A. Reitz); Membership (F. W. Peikert); Nominating (H. H. Nuernberger); Planning (R. W. Kleis); Public Relations (G. C. Krieger); Government Liaison (A. A. Stone); Secretaries (J. L. Butt); *"Engineer"* Editorial Advisory (H. J. Hansen); *"Engineer"* Technical Advisory (W. J. Ridout); Computer Applications (W. W. Gunkel and H. W. Van Gerpen); and Technical Planning (T. W. Edminster).

H. H. Nuernberger will serve on the Board of Directors, with L. H. Skromme as alternate. Other committees and their ASAE representatives to be continued as in 1960 are as follows: Engineering Manpower Commission (W. M. Carleton, with addition of T. E. Long and F. W. Riddle); International Relations (E. W. Tanquary, L. H. Skromme, and E. G. McKibben); Who's Who in Engineering (J. L. Butt); and National Water Policy Panel (J. G. Sutton and M. L. Nichols).

The addition of ASAE brings the total EJC society membership to 23. Constituent societies include: American Society of Civil Engineers; American Institute of Mining; Metallurgical and Petroleum Engineers; The American Society of Mechanical Engineers; American Water Works Association; American Institute of Electrical Engineers; American Society for Engineering Education; American Society of Heating, Refrigerating and Air-Conditioning Engineers; American Institute of Chemical Engineers; The Society of American Military Engineers; The American Institute of Industrial Engineers; and American Society of Agricultural Engineers. There are two societies holding National Associate membership and eight holding Regional Associate membership. Two societies hold Affiliate membership.

F-M WEAR PLATE "RIDES HERD" ON TURBULENT PRESSURE



IN CESSNA'S NEW HYDRAULIC PUMP LINE, F-M WEAR PLATE DIAPHRAGMS KEEP FLUIDS IN LINE to deliver pressures up to 2000 psi for aircraft, farm and construction equipment, many other hydraulic applications. These wear plate diaphragms maintain positive contact with gears to assure high, uniform pressure. To provide a bearing surface for this job, Federal-Mogul applies a high-density bronze to steel by a special sintering process. F-M high-density bronze prevents fluid absorption, and it affords good lubricity, needed because some hydraulic fluids are poor lubricants. To further prevent the escape of hydraulic fluid, these F-M diaphragms are manufactured for a snug, close-tolerance fit in the pump housing.

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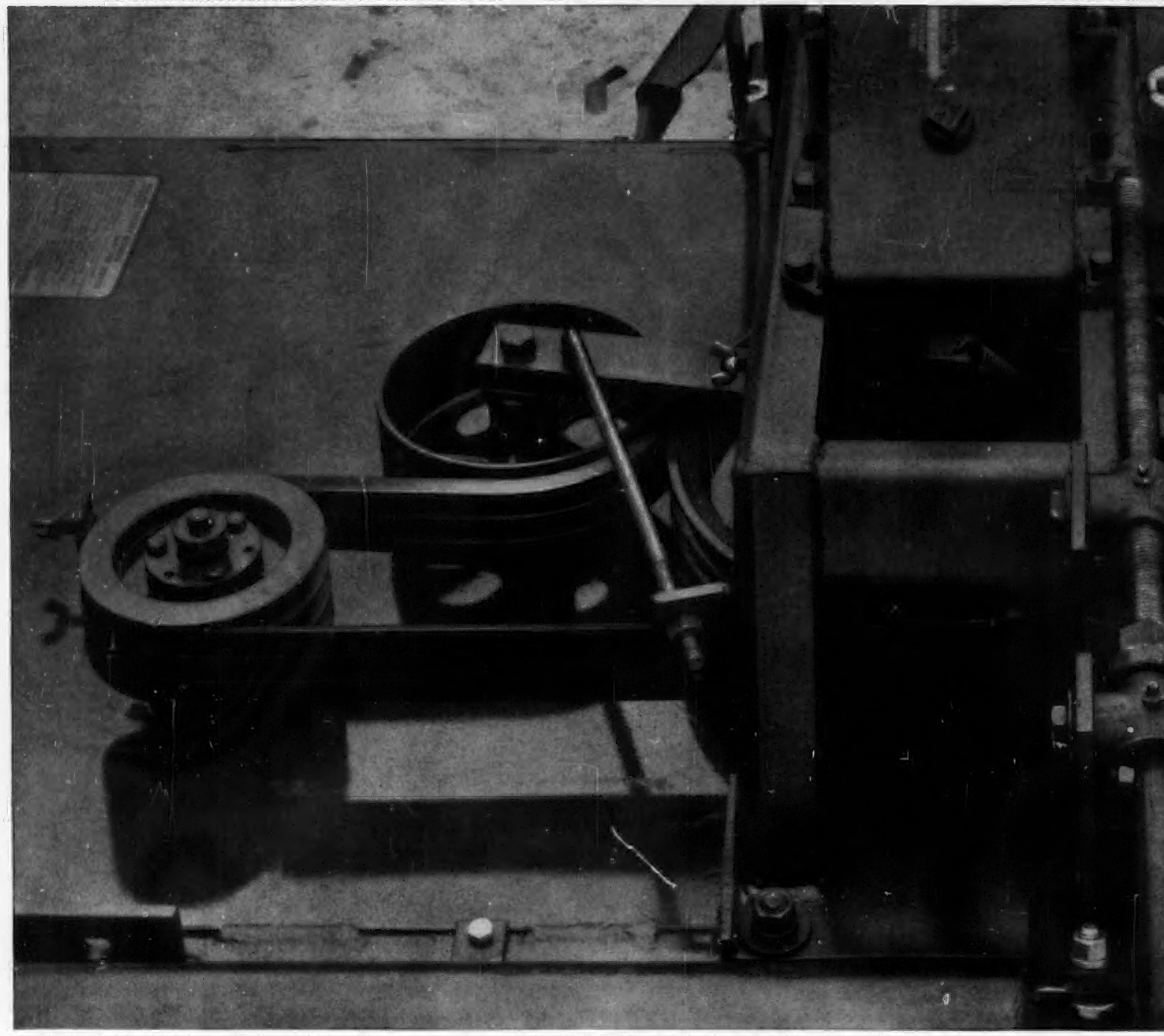


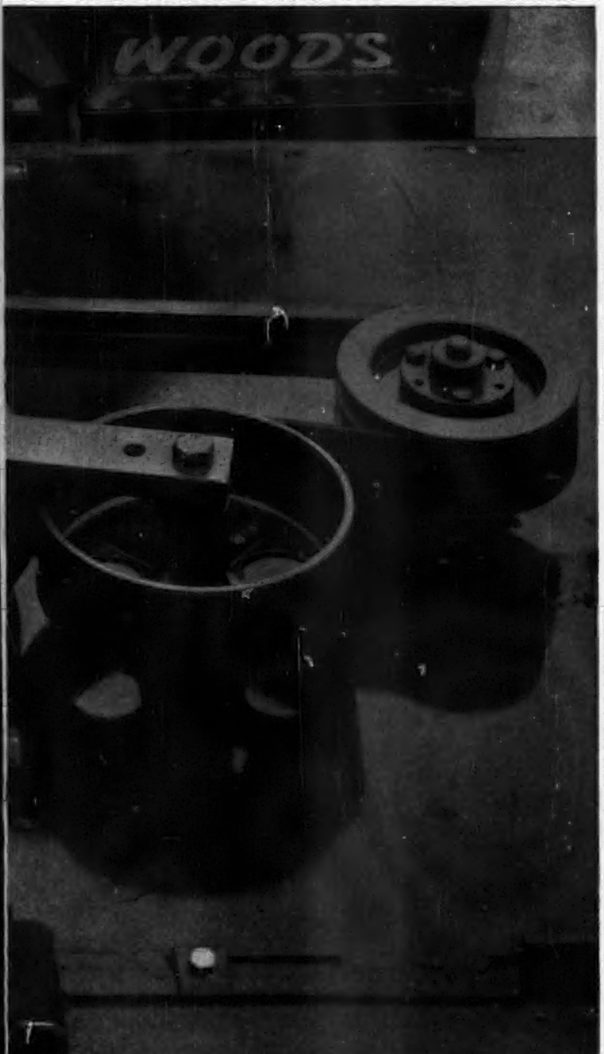
Dayton agricultural V-Belts soak-up "*astonishing*" shock loads

Ever see a rotary mower that could lop the top off a four inch concrete highway marker, or cut an 80 inch swath through a stand of three inch saplings? That's what we mean by "astonishing." This Woods, Model 80 Rotary Mower-Shredder does it with ease. What's more, it can withstand such punishment year after year.

To absorb the tremendous impact involved, Woods uses Dayton V-Belts exclusively. Their superior strength, length stability and resistance to abrasion is perfectly adapted to this rugged duty, which ranges from corn-stalk shredding to highway right-of-way maintenance.

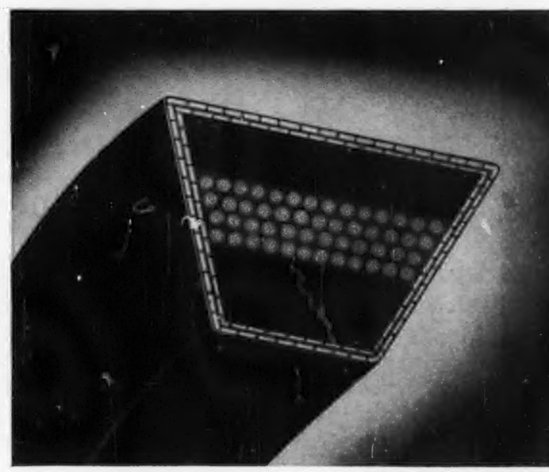
"Dayton's V-Belts," advises Mr. Wood, President, Wood Brothers Manufacturing Co., Oregon, Ill., "absorb shock loads better than a direct drive would . . . [and] protect not only our mower, but several thousand dollars worth of tractor as well."

"We settled on Dayton [B-105 V-Belts] after our own tests, as well as careful observance of field performance, showed that the Dayton product lasted almost *twice as long* as any other belt."



Cleverly designed idler wheels maintain proper belt tension but create torturous reverse bend in belt. The Dayton V-Belts installed are designed to be unaffected by such stresses.

Dayton engineers, working from Wood Brothers specifications, designed a belt of the proper size, tensile strength, composition, etc., to meet their exacting requirements. The resulting belt was just the right answer for Wood's rotary mower . . . a rugged belt that would last a long time.



Dayton Back Side Idler® V-Belt

Unsurpassed in the agricultural field for general heavy duty work, the Dayton B.S.I. V-Belt is specifically designed to flex easily and resist stresses and heat build-up caused by reverse bending. Maximum strength is assured by high tenacity cords.

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Report to Readers . . .

WOOD BRICKS – NEW DEVELOPMENT IN BUILDING-CONSTRUCTION TECHNOLOGY

One of the latest ideas in the development of materials for building construction is the "wood brick." It got its start in South America, principally Chile, and it was introduced into the United States by a Texas development company. . . . . Wood bricks are tongued and grooved to expedite construction, and only ordinary hand tools are needed in their use. Skilled labor is not a requirement. . . . . The basic "wood brick" is 3$\frac{5}{8}$ in. square, and it is made in different lengths: "full block," 20 in.; "half block," 10 in., and two other lengths, 16$\frac{3}{8}$ in. and 13$\frac{5}{8}$ in. for corners and tees. Holes are factory drilled for two 8d nails in each brick, and, for additional strength, glues may be applied between bricks. . . . . The wood bricks are designed to replace the separate interior and exterior elements of conventional wall construction whether of wood, brick or stucco.

PHYSICAL FACTORS AFFECTING FARM MACHINE CAPACITY AND EFFICIENCY

An Alabama AES agricultural engineer reports that the physical size of farm fields, together with contour and row length, markedly affects the capacity and efficiency of farm implements. In a study of two-row cultivator performance in two different fields, this engineer found that the capacity of the implement could be increased by one acre an hour when used in fields having uniformly long rows, as compared to an irregular-shaped field having a high percentage of short rows. Turning time in the field with the long rows was only 3 percent, but it increased to 20 percent in the irregular-shaped field. . . . . The Alabama engineer recommends combining small adjoining fields into larger fields to provide longer rows and thereby increase machine capacity and efficiency. He also points out that fields with parallel terraces are more efficient than those with conventional terraces.

PRESSURE-TREATED FENCE POSTS GOOD FOR 30 YEARS OF SERVICE

Based on actual service tests conducted by the U. S. Forest Service, pressure-treated wood fence posts can be expected to provide over 30 years of useful service life. So reports the U. S. Department of Commerce. This long period of usefulness is not to be expected, however, unless the posts have been pressure-treated with oil-type preservatives in accordance with the new USDC standard specifications, recently announced. . . . . It is understood that another USDC standard, now under consideration, will cover posts treated with salt-type preservatives and will be based on the same tests as used for oil-type preservatives.

TRACTOR GIVEN MAJOR CREDIT FOR INCREASED FARMING EFFICIENCY

USDA agricultural economists have been compiling data that credits the modern tractor with the major share of the extraordinary increase in farming efficiency in recent years. The introduction of the internal-combustion tractor on American farms early in this century was in fact the open-sesame that set in motion the flood tide of mechanization in agriculture. . . . . The USDA found there were 5.16 million tractors on American farms in 1959. This represented a net increase since 1945 of nearly 2.7 million. . . . . One of the more significant trends in tractor development is that toward lighter weight. In 1958, for example, tractors rated at 22 dhp weighed only one-third as much as those of similar rating produced 50 years earlier. . . . . In 1950, tractors using gasoline as fuel made up about 90 percent of the wheel tractors then on farms. However, by 1959 more than one-third of the wheel tractors produced were equipped to burn diesel fuel or liquid petroleum gas. . . . . As to how long tractors last, the USDA study based on 1927 to 1956 statistics indicates a useful life average of 16 years. In 1956 about two-thirds of the wheel tractors on farms were less than 10 years old, the average age being 9 years.

(Continued on page 114)

. . . Report to Readers *(Continued from page 112)*

HAY BALERS USED TO BALE SEED COTTON FOR TEMPORARY STORAGE

To relieve gin yard congestion – one of the symptoms of mechanization – at the height of cotton harvesting, USDA agricultural engineers are experimenting with hay-baling equipment for baling cotton for temporary storage prior to ginning. They found that seed cotton of about 7 percent moisture could be baled in this way and stored up to three months with little loss in quality. . . . . If this method of storing cotton temporarily proves satisfactory, it will permit processing the crop at the slower rates desirable for producing high-quality lint. . . . . Another thing, baled cotton would be easier than bulk cotton to handle and store, and it is possible that bales of high-moisture cotton of lower than normal densities can be dried with hay-drying equipment. Also, bales could be hauled from the field on flat-bed trailers and unloaded with fork-lift trucks. . . . . Effect of baling and storing on quality is to be investigated, as well as cost of baling and handling.

SOIL PACKERS USED TO ANCHOR MULCH TO RESIST HIGH WINDS

The soil packer can be a highly effective implement for protecting grass seedings in areas subject to high winds. This was shown in tests made in Kansas by USDA soil scientists in cooperation with the Kansas AES and the U. S. Navy. Packers with smooth or cutaway disks spaced not to exceed 4 in. apart were found to anchor 96 percent of straw or hay mulch against test winds up to 85 mph. (Cutaway disks, say researchers, proved more effective on the heavier mulches.) V-tread, rolling-wheel packers anchored 72 percent of the mulch material; plate-punch packers, 62 percent, and L-rod packers, 52 percent. . . . . Difficulties with soil penetration and disk clogging were overcome by spacing the disks about 8 in. apart for one pass over the field and 12 in. for two passes at right angles to each other. Penetration of the soil by at least 2 in., but not more than 3 in., was required to anchor and secure the mulch against high winds. . . . . Three tons of wheat straw or 2½ tons of native hay were required for good protection of easily erodible sandy soils. . . . . In the case of slopes too steep for the use of soil packers, it was found that seedings could be mulched with straw or hay held in place by rapid-curing liquid asphalt.

ENGINEERS DEVELOP MACHINE FOR HARVESTING CHERRIES AND PLUMS

One of the most promising of recent efforts to mechanize fruit harvesting has been the work of a USDA-Michigan AES research team of agricultural engineers and horticulturists to devise equipment that will eliminate the slow, costly method of hand picking red tart cherries. The objective of the researchers has been to reduce the number of pickers, lower the cost of picking, and maintain on-the-tree fruit quality. Over a period of three seasons, shaking and collecting equipment and methods of various types were tried, and in general it was found that mechanization saved time, money and labor. . . . . A tractor-mounted boom shaker, with a rubber-covered claw at the outer end of the boom that clamps to the tree limbs and is hydraulically activated to shake the fruit from the tree, removes 95 percent of the cherries from the trees. For catching the cherries, several types of lightweight rectangular or semicircular folding canvas units were designed. Also various combinations of handling equipment were developed. . . . . The researchers say that the effectiveness of mechanized cherry harvesting will depend on such factors as structure, spacing and size of trees, also on yield, orchard terrain, equipment and handling methods. . . . . An important outgrowth of this research is that most of the cherry-harvesting equipment can also be used for picking Stanley plums for processing. It is possible with the boom-type shaker to remove 93 to 99 percent of the plums from the trees, depending on maturity of fruit and tree shape. Also, the quality of mechanically picked plums compared favorably with hand-picked fruit.

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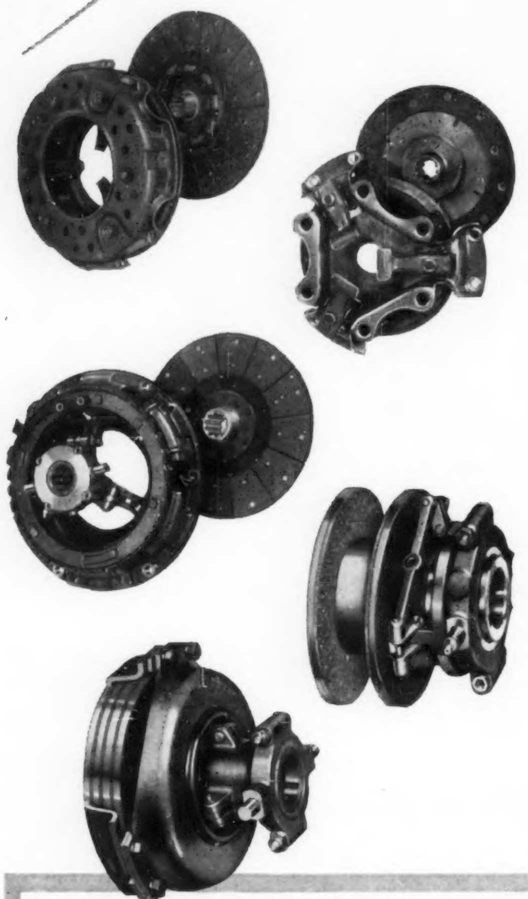
by ROCKFORD

Positive, full-motion driving power with cushioned starts and controllability . . . this is Dynamic Power Control. Rockford offers an ultra-wide range of proven power controls for all types of agricultural, automotive and industrial machinery. Rockford's complete engineering design service is available at no cost or obligation. All clutches are quality-built and thoroughly tested for enduring dependability. Write today for illustrated brochure.



SPRING-LOADED CLUTCHES
These rugged clutches drive thousands of tractors, farm machines, graders, loaders, haulers and trucks. Clutches dampen vibration and engage smoothly. Foot pedal or hand lever pressure disengages clutch. Torque loads to 2,530 ft. lbs.

COMPACT SPRING-LOADED CLUTCHES
Rockford small-diameter clutches allow smooth gear shifting and engagement ease. These efficient power-links transmit full-power for farm tractors, garden tractors, small farm equipment and trucks. Sizes from 6 inches . . . Torque loads from 50 ft. lbs.

OVER-CENTER CLUTCHES
The clutches with built-in durability are used where disengagement and engagement may be for long periods of time. Heavy duty tractors, crawlers, road building equipment and many agricultural machines are driven by over-center clutches. Torque loads from 365 to 3,235 ft. lbs.

COMPACT OVER-CENTER CLUTCHES
Thru-shaft drives, cut-off drives, sprocket, pulley, and special combination drives are all possible with these high-torque compact clutches. These versatile power-links drive combines, conveyors, cultivators, elevators, garden tractors, mowers, seeders and threshers. Torque loads from 360 inch lbs.

LOC CLUTCHES
Compact LOC clutches are used on farm tractor traction drives, tractor PTO drives, combines, conveyors, crop blowers, cultivators, elevators and threshers. Simple self-contained design allows easy application. Oil or dry operation. Torque loads range from 28 to 240 foot pounds.

ROCKFORD CLUTCHES

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Two NEW John Deere Hay Conditioners

New 21 CRIMPER and New 31 CRUSHER make better hay by cutting curing time up to 50%

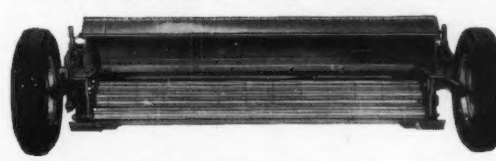
The John Deere hay equipment line-up for the 1961 season includes two new Hay Conditioners: the 21 Crimper and the 31 Crusher.

Conditioning hay—whether it's crimped or crushed—has become a definite part of haymaking. Where rainfall is heavy, it's easy to see why reducing curing time as much as 50 per cent with a John Deere 21 or 31 Hay Conditioner is important. Farmers more than double their chance of putting up hay without costly rain damage.

In drier climates, where rain is only an occasional hazard, a John Deere shines again by improving hay quality under the merciless rays of the hot sun. In conditioned hay, leaves and stems cure at the same rate. This reduces the chance of the leaves being baked . . . of becoming brittle and falling off when raking and baling the crop. Conditioned hay is more palatable—sells for higher prices, too.

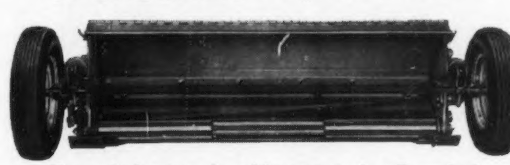
With machines like these, it's no wonder that the John Deere franchise is the most valued in the farm equipment industry.

21 CRIMPER Hay Conditioner



Two interlocking, malleable iron rolls on the 21 Crimper Hay Conditioner kink stems at two-inch intervals to reduce curing time.

31 CRUSHER Hay Conditioner



The spiral-grooved, rubber-covered roll and the fluted steel roll on the 31 Crusher Hay Conditioner bruise stems to speed curing.

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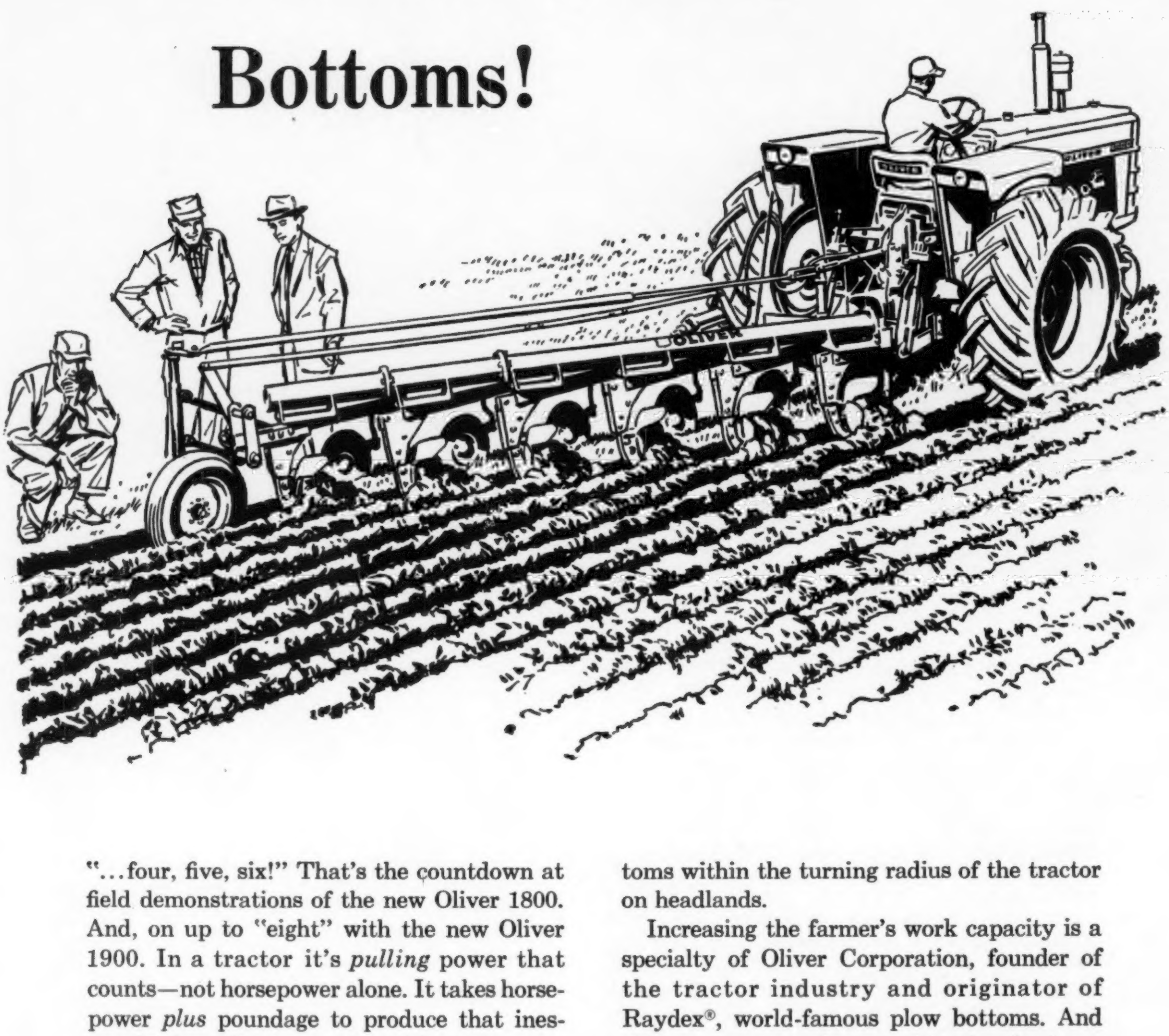


"...four, five, six!" That's the countdown at field demonstrations of the new Oliver 1800. And, on up to "eight" with the new Oliver 1900. In a tractor it's *pulling* power that counts—not horsepower alone. It takes horsepower *plus* poundage to produce that inescapable ingredient—*traction* without slippage.

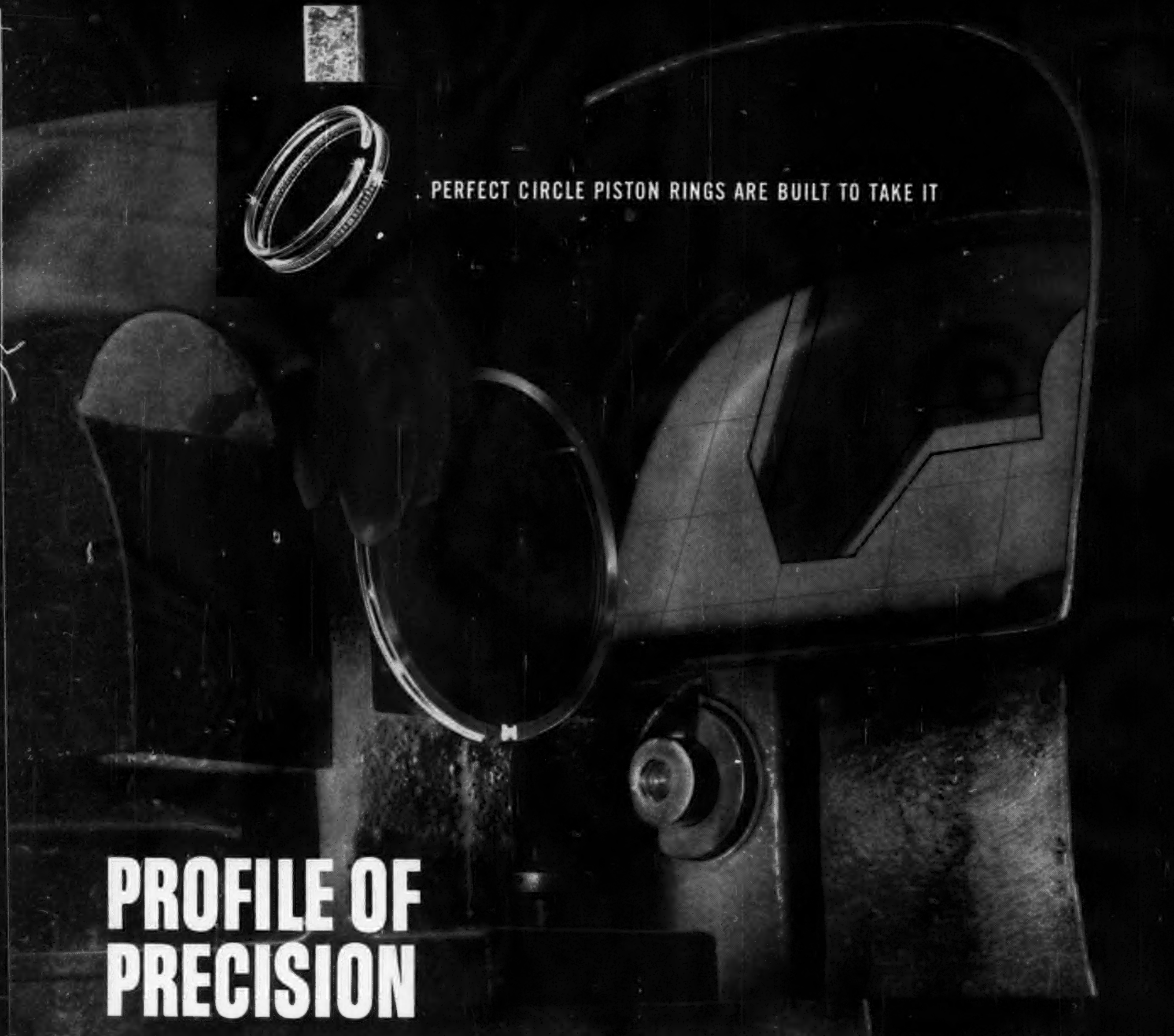
"And look at the clean coverage," exclaim farmers who recognize that plowing is the most important field operation of all—as much as three-fourths the entire tillage job, say some.

Here you see a perfectly matched work-team—an example of coordinated Oliver engineering. Up front is the weight-balanced 1800 Row-Crop® tractor—behind: a new, draft-balanced, semi-mounted plow with a pivoting drawbar and tailwheel that swing all six bottoms within the turning radius of the tractor on headlands.

Increasing the farmer's work capacity is a specialty of Oliver Corporation, founder of the tractor industry and originator of Raydex®, world-famous plow bottoms. And this new tractor-plow combination begins a new era in farming efficiency—confirms Oliver's leadership in agricultural equipment development.

OLIVER CORPORATION, CHICAGO 6, ILLINOIS

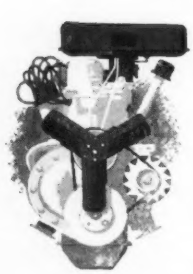
OLIVER



You are looking at the profile of a piston ring magnified many times on a powerful comparator. These highly-accurate optical devices are used in the factory to compare finished rings with standard dimensional specifications.

The comparator is but one of the many sensitive instruments employed by Perfect Circle to maintain uniform high quality in all production rings. Such precise control of machine operations assures you of better ring performance.

Whatever the need, Perfect Circles are built to take it. Put your trust in the ring preferred by more engine makers and mechanics than any other—Perfect Circle.



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Agricultural Engineering

March 1961
Number 3
Volume 42

James Basselman, *Editor*

Who Speaks for the Engineer?

A. B. Kinzel

Vice-president of research, Union Carbide Corp., as president of Engineers Joint Council, addresses ASAE Winter Meeting General Session

A. B. Kinzel

ACCORDING to the Bible, our physical world was created out of chaos. From an organizational standpoint, our engineering world grew out of a need for communication and has now reached a state of chaos!

When you stop and think about it, most societies are started by individuals with similar interests who desire to share these interests with each other. The first engineering society to be formed in the United States was the American Society of Civil Engineers. It came into being in 1852 and was organized for just such a purpose. The need for communication was great, for as yet there were no engineering schools in this country, or other means of sharing interest in this expanding field. Rensselaer had been organized but not as an engineering school and MIT began its instruction only after the Civil War.

The hoped-for communication, however, became lost in the dust of tremendous strides that engineering was making in all directions. Engineers began to specialize. The mining engineers decided that their problems were sufficiently different from those of the civil engineers to warrant a separate society. Thus the American Institute of Mining Engineers, now known as the American Institute of Mining, Metallurgical and Petroleum Engineers, became the next of the great American engineering societies to be formed. And so it went in other major areas, such as electrical, mechanical, and chemical engineering. Still the technology and science developed. Soon even these groups didn't seem to be sufficient. As a result, we now have the Institute of Radio Engineers, the Nuclear Society, the Heating, Refrigerating, and Ventilating Engineers, etc. Your own society is typical of a group that has a special interest, which requires a degree of communication that cannot be found in existing societies, and is large enough to warrant a separate, independent organization.

The result of all of this? I call it chaotic splintering of the engineering profession, societywise and organizationwise!

The American Chemical Society was formed for the same purpose as the American Society of Civil Engineers. However, as the science of chemistry advanced and the organic chemists decided that they wanted to discuss subjects of specific interest to themselves, they didn't form a separate society. They organized a special group within the American Chemical Society and set a pattern for the entire organization. Today the American Chemical Society has a great many groups recognized as such who meet separately but who all pledge allegiance, as it were, to the American Chemical Society. The result is a coherent organization that is not paralleled in the engineering fraternity.

The lawyers have done the same thing as the chemists, and the doctors of medicine have followed suit. In these three organizations there is a unity that gives them a coherent voice with respect to public affairs and a single public image. Like it or not, the respect that the public has for these people is greater than it is for those in the engineering profession.

Despite all of this splintering, however, there has been, particularly in the last decade, a unifying and an integrating force at work. While it is true that a civil engineer, a mining engineer, and an agricultural engineer, all have different specific problems, many of the problems overlap and are interdisciplinary. Agricultural engineers certainly cross lines technologywise with both mechanical and electrical engineers. In fact, you probably number among your members a great many who were trained in these fields, but who have expanded their activity. Yours is indeed a group in which many engineering disciplines are constantly in interplay.

The necessity for engineering teamwork is recognized. Nevertheless, there is no single voice in this country today that speaks for the engineer or even a good definition of an engineer. The closest that anyone has come to a publicly acceptable definition is that "an engineer is an engineer if he is registered as an engineer." In most of the fifty states there are laws that require an engineer to register if he is to work in the public domain. The basic concept of these laws is that you must be licensed, if you are to operate in such a way that the results of your work can affect directly the health and welfare of the public. Now I'm not going to argue whether the licensing is good or bad. I will say, however, that it is a roundabout and an inexact way to define the engineering profession. There are approximately 600,000 engineers in the

(Continued on page 131)

NOTICE: ASAE has been advanced in grade from National Associate to Constituent membership in EJC. For further details see page 106.

An address before a general session of the Winter Meeting of the American Society of Agricultural Engineers at Memphis, Tenn., December 1960.

Value of Differential Locks for Farm Tractors

M. Lynne Geiger
Member ASAE

Benefits appear to be matched by lower cost means for either normal or severe tractive conditions

NOW that differential locks on farm tractors have been introduced on the American market, it is in order to inquire as to their value to farmers.

Perhaps the availability of locking or spin-resistant differentials as optional equipment on several passenger cars in recent years has attracted attention. Such differentials have been incorporated in trucks, especially off-the-road types, for many years.

Possibly the availability of differential locks on many European tractors has increased domestic interest. One German textbook listed ninety-two tractors, of which sixty-one had differential locks (1)*.

If locking differentials facilitated the movement of trucks and automobiles through treacherous tractive conditions, and if such devices were popular on European tractors, some investigation of differential locks was justified. Differential locks seemed worthy of tryout on farm tractors to reduce wheel slippage, especially of the land wheels while plowing, where there are weight and surface differences at the drive wheels.

Therefore, to evaluate differential locks on farm tractors, a study was made prior to the appearance of European-built tractors with differential locks on the United States and Canadian markets.

Tractive Effort and Torque

A comparison of tractive effort and torque relationships for tractors with conventional differentials, conventional differentials with one wheel braked, and locked differentials was desirable in evaluating differential locks.

Conventional automotive differentials divide torque equally between the two drive wheels if the slight internal friction is neglected (2). Therefore, the vehicle driving ability is twice that of the wheel with the lesser tractive effort, as shown in Fig. 1*(a)*, where T equals torque and P equals pull. A low coefficient of friction, k, under one wheel causes excessive wheel spinning, or total immobility, as on ice. Weight distribution may be just as significant as the traction coefficient in affecting tractive effort of trucks and tractors. W represents weight in Fig. 1.

Wheel braking can benefit tractive effort by increasing the torque required to drive the wheel with the poorer traction. The torque to each axle shaft is equal, as is the case with the conventional differential without braking. The tractive effort for the better side is greater than the tractive effort on the poorer traction side, as shown in Fig. 1*(b)*. This is true because part of the input torque on the side with the poorer traction wheel is absorbed and lost in the brake. The use of brakes to minimize wheel spinning depends on operator control, causes brake wear, wastes some engine power, and promotes engine stalling.

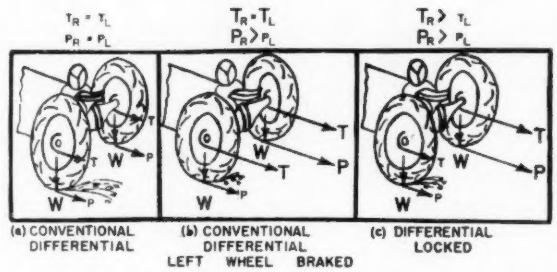

Fig. 1 Tractive effort and torque diagrams. (Assumed conditions: All W values are equal; k_R is greater than k_L in all cases)

A differential lock is another means for preventing immobility when one wheel loses traction, of minimizing excessive spinning of the wheel with poorer traction, and for reducing tire wear. The torque is higher on the side of better traction when a lock is engaged. Tractive effort is improved by taking full advantage of the traction on the better side, as shown in Fig. 1*(c)*, instead of being limited to twice the traction on the poorer side. This net gain is the same as for braking with a conventional differential, but the wheels must turn or spin at the same speed. Differential locks may or may not require operator control.

It can be concluded from this theoretical analysis that the effects of braking the poorer traction wheel or of engaging a differential lock appear equal where vehicle propulsion is limited by traction alone. Where mobility is limited by available power as well as traction, the differential lock may be somewhat better. Perhaps this explains the availability of differential locks in Europe, where tractors of low horsepower are common.

Differential Locks

The following primary functional specifications were established for a tractor differential lock:

1 Maximum driving torque to be available to the wheel with better traction, in both forward and reverse directions, regardless of operating conditions and surfaces, and with any unbalanced torque caused by offset loads

2 All parts to withstand transfer of full engine torque to one axle shaft, minimizing shock loading as much as possible

3 Conventional differential action to be available for turning by automatic or manual disengagement of the locking mechanism, to permit the outer wheel to

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Paper presented at the Winter Meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division.

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*Numbers in parentheses refer to the appended references.

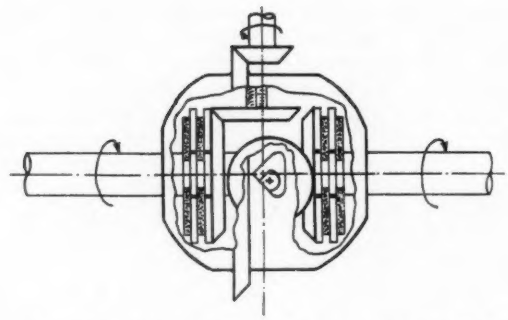

Fig. 2 Schematic of one automotive locking differential in driving locked position

drive in turns, to permit individual wheel braking for sharp turns, and to avoid interference with steering

Other desirable characteristics were long unit life with minimum subjection to abnormal loads and wear, efficient operation regardless of some wear, minimum cost, and maximum parts interchangeability with present production tractor parts.

A common automotive locking differential is illustrated in driving engagement in Fig. 2. This is sometimes called a torque bias or unequal torque differential. Driving torque causes locking by engagement of the friction clutch on each side through cam actuation. When one wheel spins, the cam action is reversed which releases the friction clutch at the slipping wheel, and thus the greater portion of available torque is directed to the better traction wheel. The action is similar in a turn, in that the outer wheel overruns and the inner wheel drives.

This type of automotive locking differential was not adapted to the common two-wheel-drive tractors because tractors must have the outside wheels driving during turns, individual wheel braking, and short turning radii. With this automotive locking differential, the driving is done by the inner rear wheel in turns, while the outside tractor wheel must drive to pull heavy loads in turns. Individual wheel braking assists even a bare tractor in making sharp turns on loose soil surfaces. The desired turning radii of tractors for better maneuverability are very short compared to those of automobiles and trucks.

An automotive slippage-resistant differential with a preloaded clutch is shown in Fig. 3. Slippage and turning are always resisted by built-in torque.

Theoretically, this type should be adaptable to tractors for limited torque unbalance, assuming that the engine had enough power to override this resistance during turns. However, excessive friction, heat, and power loss would characterize this type of differential under some tractor operating conditions.

A European tractor differential lock is shown in engaged position in Fig. 4. One axle shaft is locked to the differential carrier through a sliding jaw clutch. This unit acts as a conventional differential when not engaged. Foot pedal actuation is normally used to engage the lock for emergency traction use only. Foot-pedal release returns the differential to conventional action. The foot-pedal engaging operation is somewhat equivalent to applying a brake, but no power is lost. Some differential locks are hand operated and others have automatic control (1).

For our experimental work, a rather simple differential lock, somewhat similar to European design, was built for investigation of functional characteristics.

Field Operation

Earlier German investigation had shown that tractors with differential locks, when operated on side slopes, tended to pull uphill while tractors with conventional differentials drifted downhill. These tests were conducted in plowing slopes of 18 degrees or 33 percent (1). The normal downhill drift was undoubtedly caused by the inadequacy of the ground reaction force to offset the downhill component of the vehicle weight. The uphill pull with the locked differential was concluded, without our knowing all the details, to result from the better traction of the much heavier downhill drive wheel which, even though rotating at the same speed as the uphill wheel, slipped less and propelled the tractor up the slope. The uphill pull was also concluded to be influenced by the added effective moment exerted by the offset draft of their narrow two-bottom plow. The opposing tendencies of downhill drift and improved downhill wheel traction might balance if it were possible to select the proper slope for given tractor weight distribution, configuration, and draft load. Incidentally, the advantages of differential locks for hard-ground plowing and for plowing slightly rolling land were considered already well known by the original German author.

Our tests indicated that steering of the tractor on large contour radii was not impaired by a locked differential. However, sharp turning at headlands was impossible with the differential locked. The front wheels skidded ahead

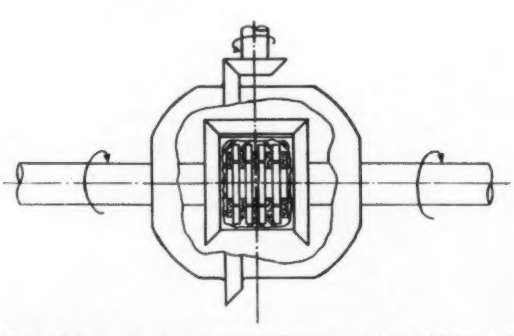

Fig. 3 Schematic of automotive slippage-resistant differential

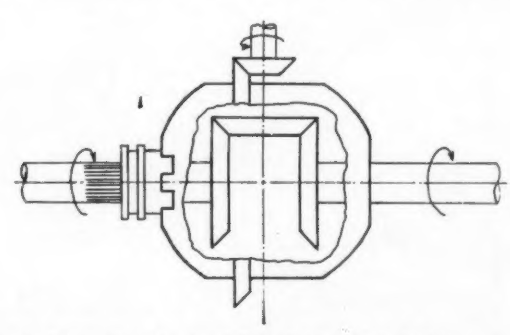

Fig. 4 Schematic of tractor differential lock in locked or engaged position

. . . Value of Differential Locks

unless the differential was free. Steering to correct for side slope drift while plowing with a three-bottom plow was restricted by a locked differential. This observation, which at first appeared not to concur with the German results, was made in different conditions and with a plow of offset draft to the opposite side.

Side pull was much more apparent with the differential locked than with it free when using a three-bottom plow with offset draft. Such side pull was not observed when a two-bottom plow was used.

Arthur W. Clyde of Pennsylvania State College in 1946 did work with an unequal torque differential, in which the right side gear was larger than the left gear (3). This gave more torque at the right wheel and thereby shifted the center of pull to the right. He was interested in improving tractor steering by aligning the center of pull with the offset draft of a single-bottom plow which had offset pull to the right side.

Clyde concluded that the tractor center of pull could be effectively shifted to improve steering with an offset pull and that this had no apparent bad effects when pulling from the center. The converse of this is also undoubtedly true. That is, an equal torque conventional differential ideal for center loads would not be objectionable for offset pulling. Incidentally, Clyde reported observing little slippage difference between right and left drive wheels with both his unequal torque and regular differentials.

Numerous times during our tests, when the tractor was immobilized because of left wheel spinning, the differential lock was engaged after declutching had stopped the spinning wheel. Only once did the tractor proceed with the aid of the locked differential alone. In most cases, it was necessary to lift the plow to reduce the draft load and to momentarily increase weight transfer or to release the lock and apply one brake to increase the effective torque to the wheel in the furrow. In this situation, braking appeared somewhat better than the lock. This may have resulted from intermittent, or feathering, braking action whereas the lock was either fully on or off. Available engine power was not a limiting factor in these conditions. Brake application alone or in combination with implement lifting was able to sustain forward motion through isolated adverse tractive conditions without a locked differential. Observation did not fully support the theoretical analysis.

Europeans may gain more advantage with differential locks than North Americans because of more adverse conditions farmed. It is understood that in Europe very wet plowing and harvesting of sugar beets from muddy fields often provide continuous severe tractive situations which must be overcome to produce some crops.

Our early tests were conducted on sand and heavy sod where the differential use was alternated between locked and conventional action. The tractor stalled due to excessive left wheel spinning only when both wheels seemed to slip excessively. Differences in rear wheel slippage appeared small at normal wheel-slippage levels. Because the early field trials of the differential lock showed no obvious advantages, measurements of slippage differences between the two wheels with no lock were necessary to evaluate the need for such units.

Procedure

Slippage data were collected in plowing operations by reading revolution counters mounted at each rear wheel. In early tests alternate passes were made with the differential locked and free to give comparative data as well as operational response. Occasional check passes to establish a no-load, non-slip base were made by driving the tractor with plow lifted across the same land distance as normally plowed.

The following formula was used to calculate slippage of each wheel:

$$S = \frac{L - B}{L} \times 100$$

where S = wheel slippage in percent
L = wheel revolutions when plowing
B = wheel revolutions with no load

This method, while not the only one recognized, gives the slippage relationship as prescribed in the ASAE Standard Agricultural Tractor Test Code used by the Nebraska Test Board (4).

Slippage difference was expressed by the following formula:

$$D = S_{lw} - S_{rw}$$

in which D = wheel slippage difference in percent
S_{lw} = left wheel slippage in percent
S_{rw} = right wheel slippage in percent

Results and Discussion

It should be recognized that these results are presented as indications only. Some crudeness of measurement, simplification of many variables, and non-repetitive field conditions all tend to restrict the validity of specific values.

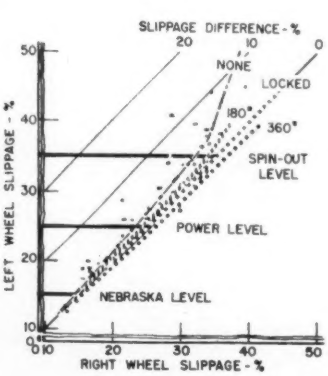

Fig. 5 Effect of differential lock and wheel weights on wheel slippage when plowing dry, sod-covered heavy soil with a two-bottom mounted plow

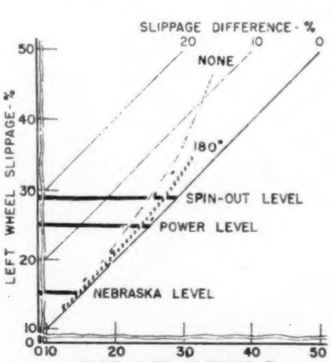

Fig. 6 Effect of wheel weights on wheel slippage when plowing wet, grass-covered heavy soil with a two-bottom mounted plow

Fig. 5 shows the relative effect of a locked differential and various amounts of cast wheel weights on wheel slippage in plowing dry, sod-covered heavy soil with a two-bottom mounted plow.

Left-wheel slippage is plotted against right-wheel slippage with the slippage difference showing directly on the diagonal lines.

Drive-wheel slippage shall not exceed 15 percent for tractors equipped with pneumatic tires according to the Agricultural Tractor Test Code as used by the Nebraska Test Board in 1959 for tests on the paved track (4). This limit had been 16 percent slippage on the cinder track before paving.

The 25 percent line indicates the slippage level on agricultural soils at which drawbar horsepower is often a maximum. This maximum power level may vary with different surface conditions.

The spin-out level denotes the percentage of left-wheel slippage above which the left wheel spun, immobilizing the tractor one or more times during a test trip across the field. The upward break in the curves above the spin-out level, is an indication of the extra slippage during spin-outs, although the brake was applied or the plow was lifted to resume progress as quickly as possible. Instantaneous slippage of 100 percent existed at the left wheel until normal recovery was made by the operator.

Differences in slippage increased as the slippage level increased, when no cast weights were used.

This trend was still evident to a lesser degree when 180 lb cast weight was added to the left wheel in an attempt to equalize the weight of the left and right wheels while plowing. Thirty pounds of weight was added to the right wheel at the same time to compensate for the weight transferred from the right wheel by the 180 lb overhanging to the outside of the left-wheel support point. Therefore, the right or furrow wheel weight was maintained essentially constant as variations were made in the left or land wheel weight.

The locked differential permitted no slippage difference. The locked differential curve fell just below the effect of 180 lb and above that of 360 lb added cast weight on the land wheel.

Addition of 360 lb to the left wheel resulted in less slippage of the left wheel than the right.

Without added weight, none of the several tests below the 25 percent power level showed a slippage difference above 4 percent. None of these runs showed any slippage difference below the 15 percent slippage level.

While rather few test points are shown for some of these curves, it should be noted that additional tests at later dates and in different conditions showed essentially the same results.

Fig. 6 covers the same conditions as Fig. 5, except that the grass was thoroughly wet from light rain. The primary difference was that the spin-out level dropped to 29 percent left-wheel slippage compared to 35 percent when the cover was dry. Slippage difference between the two drive wheels was again small below the spin-out level.

The locked differential was not tried in plowing when snow covered the ground or when a frozen surface was thawing. These conditions may be similar to wet grass. Although no numerical results were recorded in soft wet plowing in early spring, the locked differential showed no apparant advantage.

Fig. 7 shows the relative effect of a locked differential and an unlocked differential without added wheel weights for the same conditions as Fig. 5, except that a three-bottom plow was used. The slippage difference appeared to be slightly higher with the three-bottom plow than with the two-bottom plow for equivalent slippage levels. All plotted points exceeded the normally accepted slippage range.

Most of the data recorded up to this point covered slippage in excess of that normally considered desirable. Also, the slippage difference was rather slight at the lower slippage levels. Therefore, the next step was to check the range of slippage in actual farm practice for comparison with the Nebraska and power level bases.

Seven farmers who were observed at random doing field plowing in June cooperated in slippage tests. Each farmer plowed three rounds or six passes for the test runs, after which he made one no-load round to establish the slippage calculation base as in our earlier tests.

The results of wheel-slippage tests with farmer plowing are shown in Fig. 8. These results tended to endorse 15 percent slippage as a practical and reasonable base. The slippage differences in over forty runs never exceeded 6 percent. It was interesting to note that two of these seven farmers had extra weight on the left land wheels for resultant lower relative slippage.

Only two of the seven tractors consistently exceeded 15 percent left-wheel slippage. The farmer whose tractor had the greatest slippage difference had planned to buy extra cast weight to reduce his slippage level. The owner of the

(Continued on page 139)

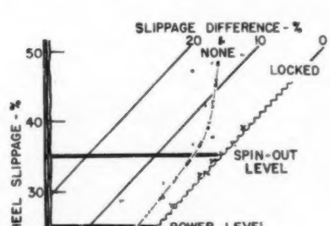

Fig. 7 Effect of differential lock and no wheel weights on wheel slippage when plowing dry, sod-covered heavy soil with a three-bottom mounted plow

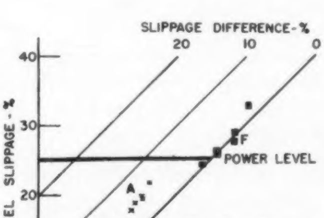

Fig. 8 Results of wheel-slippage tests with farmer plowing

Land Leveling in the Arkansas Delta

Engineering practices recommended for servicing landowners

Elwin D. Butler
Member ASAE

LAND leveling is a relatively new practice in the Arkansas delta. Six years ago U.S. Soil Conservation Service records show that no land on farms cooperating with soil conservation districts of the state had been leveled to a planned grade. Today the records show that 71,951 acres have been leveled. Numerous landowners have systematically begun to level all their land. The 27,000-acre Lee Wilson plantation near Osceola, Ark., levels approximately 1,200 acres per year, and budgets $100,000 per year for irrigation development. The 13,000-acre Pickens plantation near McGehee levels 700 acres each year at the present time. Although some large blocks of land have been leveled, the average leveling job has been between 30 and 40 acres.

Conditions for Application of Practice

There are approximately 10 million acres of nearly level, deep, fertile bottomland soils underlain with abundant water-bearing sand in the Delta area of eastern Arkansas. The average annual rainfall is about 50 in.; however, records show that drought periods are frequent during the average growing season.

The area consists mostly of deep, medium or fine-textured, slowly or very slowly permeable bottomland soils. The average intake rates are extremely low, being from 0.15 to 0.30 in. per hour for a 3-in. application of water. At saturation, these soils have an intake rate very near to zero as attested by the fact that rice can be grown on all Delta soils except the more sandy permeable ones.

Design Criteria

Land-leveling design criteria is balanced between the conflicting needs for drainage and irrigation. Experience has shown that grades flatter than 0.1 ft per 100 ft, although good from an irrigation standpoint, give inadequate drainage. Grades steeper than 0.3 ft per 100 ft provide good drainage but result in poor irrigation efficiency because of the low intake rates. For these reasons, grades between 0.1 and 0.3 ft per 100 ft are recommended.

Drainage systems must always be planned in conjunction with irrigation systems. In fact, field dimensions are usually determined by required location of drainage ditches rather than from irrigation requirements. Because of the depth of the soil and the relatively flat topography, the depth of cut is seldom a problem although it has to be considered on localized areas.

Cost and Benefits of Leveling

The average cost of land leveling has been about $75 per acre for moving about 350 cu yd per acre. Some land has been leveled where as much as 1,400 cu yd per acre were moved. It is believed that the benefits from irrigation and drainage will justify expenditures for land leveling up to $200 per acre on most soils under present conditions.

Reasons for Land Leveling

Delta farmers usually give three main reasons for leveling land, as follows:

1 Land leveling makes possible more efficient surface irrigation. Surface irrigation has certain definite advantages over sprinkler irrigation. Predominant irrigated soils, with their very slow intake rates, require larger than normal expenditure for sprinkler equipment. The sticky nature of many of these soils presents a serious labor problem when moving pipe. Most fields, however, are undulating or moundy enough that surface irrigation is impractical without leveling.

2 Land leveling improves surface drainage by eliminating low areas and reduces the number of surface field ditches required for good drainage. These surface field ditches are wide, shallow ditches that are laid off generally perpendicular to the rows in low areas. They drain the furrows and carry excess runoff to lateral and main drainage ditches. Maintenance costs are high because planters and cultivators must plow across the ditches during farming operations.

3 Land leveling facilitates the use of large farming equipment. Planters can be regulated to plant seed at a uniform depth. Cultivators and mechanical pickers operate more efficiently on leveled land.

Land-Leveling Procedures

Land-leveling procedures are patterned after those in chapter 12, Land Leveling, section 15 — IRRIGATION — of the SCS national engineering handbook. This section on irrigation is available from the Superintendent of Documents, Washington. No attempt will be made in this paper to repeat in detail material that is covered in this handbook.

The plane method of leveling is generally practiced by the SCS in Arkansas. In this method, as described in the above-mentioned handbook, the steps necessary to prepare a leveling plan are:

1 Complete the design and construction survey on 100-ft grids
2 Subdivide the area into subareas, each of which can be leveled to a plane surface
3 Locate the centroid of the subarea
4 Determine the average elevation of the subarea
5 Compute the slope of the plane of best fit
6 Determine the elevation of the plane at the centroid
7 Compute the elevation for each grid point
8 Compute the cuts and fills
9 Compute earthwork volumes.

Paper presented at the Winter Meeting of the American Society of Agricultural Engineers at Memphis, Tenn., December 1960, on a program arranged by the Soil and Water Division.

The author — ELWIN D. BUTLER — is state conservation engineer (Arkansas), Soil Conservation Service, USDA, Little Rock, Ark.

In this area of relatively flat topography the natural over-all slope of the land often falls near the 0.1 and 0.3 ft per 100 ft grade recommended for drainage and irrigation. For this reason there has been a great deal of interest in methods for determining the plane of best fit.

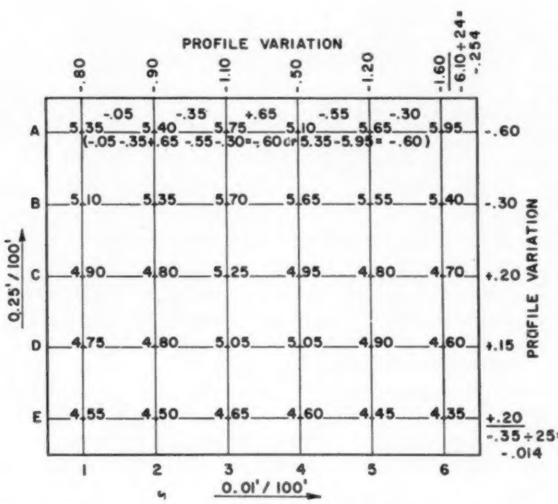

Fig. 1 The average profile method for determining the plane of best fit in a rectangular field

A Mathematical Solution

A mathematical solution for determining the plane of best fit in a rectangular field was used by C. V. Givan in AGRICULTURAL ENGINEERING for January, 1940 (vol. 21, no. 1, p. 11); he based his calculations on the theory of least squares. Another method called the fixed-volume center method by V. Subba Raju, was described in "Transactions of the ASAE" for 1960 (vol. 3, no. 1, p. 38). Anyone who has used these methods will have to admit that they are somewhat tedious and involved.

A graphical average profile method is described by R. L. Phillips in AGRICULTURAL ENGINEERING for August 1958 (vol. 39, no. 8, p. 463). There is some advantage from a checking standpoint in using a mathematical solution for the plane of best fit.

An average profile method using a mathematical approach has been used by SCS personnel in Arkansas for several years that is fairly accurate and relatively simple to use. It was suggested in June 1957 by Miles A. Robertson, GS-5 engineering aid at Marion, Ark. The use of this method can be demonstrated by the following example shown in Fig. 1 where rod readings on 100-ft grids are shown.

The slope in each 100-ft distance on each line in a given direction is determined and assigned a plus (+) or minus (—) value to indicate direction. These slopes are added algebraically and divided by the number of spaces to obtain an average slope. This process can be seen on line A of

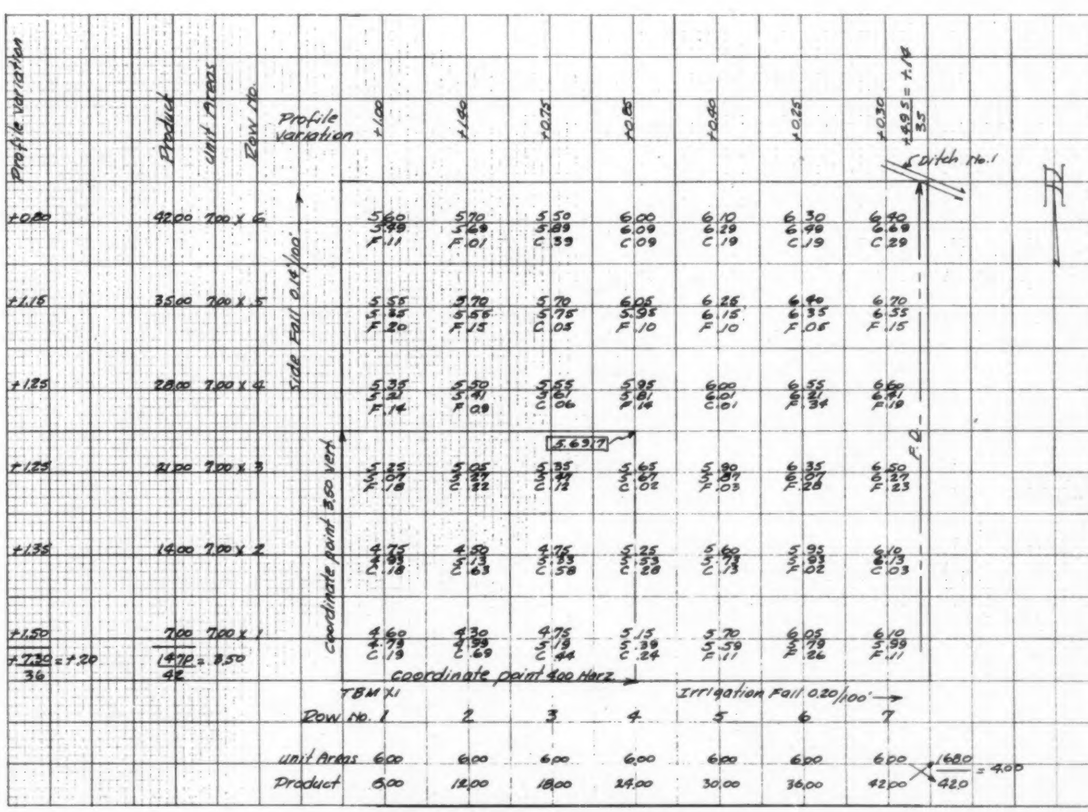

Fig. 2 An example illustrating use of the form shown in Fig. 3

the example where the difference between each rod reading is negative if the right-hand figure is larger, and positive if it is smaller. It can be seen that $-0.05-0.35+0.65-0.55-0.30=-0.60$. The average slope per 100 ft on this line can be obtained by dividing -0.60 by 5 since there are five 100-ft spaces on the line.

In practice, there is an easier way to determine the average slope by subtracting only the end figures on each line, as on line A where $5.35-5.95=-0.60$. This process is repeated on each line in a given direction and the proper algebraic sign is assigned. The algebraic sum of the end figures on each line is obtained. In Fig.1 on east and west lines, the sum is -0.35 ft. There are five spaces on each line, or a total of 25 spaces on lines A to E. The average slope per 100 ft in a west to east direction is $-0.35/25=-0.014$ ft per 100 ft. This would normally be rounded off to -0.01 ft per 100 ft. The minus ($-$) sign indicates that the grade is decreasing to the east.

The same process can be used to determine the average slope per 100 ft in a south to north direction. In this example it can be seen that the grade is -0.254 ft per 100 ft in a south to north direction.

The grades obtained in this example, using the least squares method, are -0.013 in a west to east direction, and -0.262 in a south to north direction. In each case the grades vary less than 0.01 ft per 100 ft from the grades obtained by the average profile method. On almost all fields in the Delta, slopes obtained by the average profile method are within a very few hundredths of a percent of the slopes obtained by the least squares method. These differences are insignificant in planning most land leveling jobs since quite often the plane of best fit is used only to guide the landowner and the engineer in selecting a design grade where the most economical grade is only one of several criteria that must be met.

The average profile method is a simple, rapid method that can be understood and used by non-professional personnel as well as engineers on Delta topography, with a minimum of supervision.

Use of Computation Form

To make the computations for land leveling as systematic as possible, and to facilitate checking of computations, the form shown in Fig. 3 has been adopted in Arkansas. The format was first suggested by David K. Bowen, then work unit conservationist at Osceola, Ark. The example shown in Fig. 2 illustrates the use of the form as well as steps involved in locating the centroid, average rod reading, adjustment for shrinkage, plane of best fit, and the cuts and fills at each station. The centroid in this case could have been located by inspection; however, a method is shown that can be used on irregular fields whose sides are approximately parallel.

There are literally hundreds of opportunities for making errors in the multitude of computations involved in a large field. A check on mathematical errors can be maintained as shown, in the following manner, in Fig. 3: To provide a positive check on calculations, rod readings and elevations are assumed to be accurate to four places beyond the decimal point and all calculations are carried out accordingly. The adjustment for shrinkage should be chosen to make the average rod reading at the centroid, which in this case is 5.6917, read to an even hundredths, or 5.81 in this case, on a convenient station near the centroid. Rod readings are recorded to the nearest 0.05 ft, and computations for cut and fill are shown to the hundredths of a foot to facilitate checking of figures. Cuts and fills are marked in the field, however, to the nearest 0.05 ft.

When the difference in cuts and fills, 2.03 ft in this case, is compared to the product of the number of stations times the shrinkage adjustment, or $42\times.0483=2.03$ in this example, it can be seen that the variation per stake is zero. This indicates that the centroid is correct and that there are no mathematical errors. Barring compensating errors, this method provides a positive check on all calculations, except those concerning the plane of best fit.

Often a large number of segments must be figured on the same field, and where large numbers of fields are involved in the same plantation, there must be a system for organizing computations and notes. The above-mentioned form (Fig. 3) assists with this.

Summary

Land leveling has become an important engineering practice in the Arkansas Delta area.

It is possible to service the maximum number of landowners with SCS resources by means of the following practices:

Extensive use is made of helpers furnished by the landowners

Plantation personnel are trained to obtain survey data and to mark cut and fill stakes

LAND LEVELING COMPUTATION SHEET

COOPERATOR O. L. Davis SCD AGREEMENT NO. 1112
ACP NO. 82 FIELD NO. 3 PLOT NO. 2 SEGT. NO. ______
COMPUTED BY S. Roe DATE 6/17/60 CHECKED BY R. Fry DATE 6/17/60

Total Rod Read. or Elevations		2	3	9	0	5		
Total No. Rod Read. or Elevations			4	2	0	0		
Average Rod Read. or Elevations				5	6	9	1	7
Adjust to Nearest Sta:								
.14 x 50 = +.0700								
______ x ______ = ______								
Net Adjustment = +.0700					0	7	0	0
Adjusted R.R. or Elev. to Sta. 4N-4E				5	7	6	1	7
Adjustment for Shrinkage				+	0	4	8	3
1/ Adjustment for Avail. Borrow								
2/ Adjustment for Add'l. Fill								
Net R.R. or Elev. Sta. ______				5	8	1	0	0

1/ Adj. For Available Borrow = $\frac{\text{C.Y.} \times 0.0027}{\text{No. of Rod Read.}}$ = ______

2/ Adj. For Additional Fill = $\frac{\text{C.Y.} \times 0.0027}{\text{No. of Rod Read.}}$ = ______

Total Cuts	5.02	Total Cut-C.Y.	18593
Total Fills	2.99	No. Acres	9.66
Difference	2.03	C.Y. per Acre	192.5
Cut-Fill Ratio	62.7-37.3	No. Cut Stas.	21.0
Check: No.Sta. 42.0 x Shrinkage .0483 = 2.03		No. Fill Stas.	21.0
Total Variation = 0.00		Undisturbed Stations	0.0
Variation per Sta. = 0.00 ÷ 42.0 = 0.00		Total No. Stas.	42.0

Fig. 3 An example of a land-leveling computation sheet for maintaining a check on mathematical errors possible in the many computations involved in leveling a large field

Land-leveling contractors are encouraged to own and use their own levels to check progress of leveling operations

A short-cut method called the "average profile method" is used for calculating the plane of best fit

A form is used to systematically organize and record computations and check for mathematical errors.

... Who Speaks for the Engineer?

(Continued from page 123)

country, roughly half are members of engineering societies, and something less than one-third are registered! Nevertheless, it is a step in the right direction.

The second step was taken when the registered engineers founded a society. Then, joined by many other societies including your own, engineers formed two new distinct groups: the Engineers Joint Council and the Engineers Council for Professional Development.

The second group has concerned itself primarily with engineering education. It has done a magnificent job in reviewing college curriculums, in making suggestions to help the universities make up their curriculum, and finally in accrediting courses.

In the Engineers Joint Council, we are attempting to take care of common technological problems that arise. Transportation, for example, belongs in mechanical engineering, certainly; in civil engineering, without question, and the electrical engineers are obviously concerned. Even the miners and metallurgists are very much interested and what they do has a great bearing on it. While a connection with the agricultural people is less obvious, you certainly have a direct interest in transportation of several kinds. The study of such a wide area from a national point of view cannot be given to any one group. You've got to get them all together. In the Engineers Joint Council, we have pulled them together and we do get them together. In the study of water, a subject of great interest to you agricultural engineers, we got a number of people from the various societies together and have, over the past years, issued reports and otherwise studied the whole question of water in the United States.

This is a unifying force. Incidentally, right now there is a movement to put ECPD and EJC into a common organization so that it can speak with a still stronger voice for the engineers. Whether this can be accomplished or not in the near future remains to be seen; I will tell you though that the necessary two-thirds vote of the EJC membership has been secured.

You may say that this is all fine and dandy, but what does it get us. Well, let me make clear a very important fact: the way the technical societies are organized, and this includes your own, the engineer may not engage in legislative lobbying or the eqivalent in his own self-interest. To remedy this, the National Society of Professional Engineers was formed to permit legislative lobbying — albeit to a quite limited degree. However, the present rules of the NSPE require that its members be registered engineers. There is not much point in such a ruling when it is practically impossible, for example, for a mining engineer to become registered in most of the states. Nor were the rules set up to take care of engineers working in private corporations. The result, of course, is confusion. We of the EJC are suggesting that NSPE open their rolls to any professional engineer defined as "any qualified full member of an engineering society whose specifications for membership are adequate." This would include most of the societies in EJC and ECPD. Since most societies require that a member have several years of responsible experience before he can become a full member, this certainly is a better qualification than simple registration.

To help create a better public image of the engineer, the EJC this year issued the newspaper "Engineer." It is a quarterly designed to tell the engineering public and the membership of our constitutent societies something about Engineers Joint Council and to provide a realistic picture of our profession.

The public usually thinks of an engineer as someone who can run a locomotive or a crane. "Science" on the other hand has come to mean both science and engineering and so it is used in the public press. Well, what do we want an engineer to be? We want him to be sufficiently specialized to know how to do a job and do it effectively, and we want him to have enough breadth to realize the importance and impact of his particular job to the total picture. But how do we achieve this? First of all, we must get away from turning engineers out of school in strait jackets with a line of thought that is so narrow that they follow the handbook like sheep. And the only way we can stop this is for every individual engineer to go down to his public school system, to his local high school and find out what is being taught, what courses are being offered and, if possible, their contents. Then he should shout from the housetops about it, if it isn't right. This is one of those things that has to be a real, not a so-called, grass roots movement.

Let me close then with a plea and pledge. When you go home, each one of you individually make sure that the youngsters in your home town are getting a good scientific base in secondary school mathematics, physics, and chemistry. When they get into college or into a technical school, I can pledge you that the EJC and ECPD are working hard with the universities and the technical schools to assure a curriculum that will give the youngsters specific specialized training on the one hand and a broad feel for the whole area on the other.

Russian Farm Machinery Literature Translations

THE Office of Technical Services, Business and Defense Service Administration, U.S. Department of Commerce, has announced the availability of nine translations of Russian technical literature, as follows:

60-31750 Soviet Agriculture No. 15: Selected Translations on Farm Machinery Plants. September 1960, 17 pages, 50 cents. Translation on Mashinostroitel' USSR, 1960.

60-31751 Soviet Agriculture No. 16: Selected Translations on Farm Machinery Plants. September 1960, 26 pages, 75 cents. Translation of Mashinostroitel' USSR, 1960.

60-31752 Soviet Agriculture No. 17: Selected Translations on Farm Machinery Plants. September 1960, 13 pages, 50 cents. Translation of Mashinostroitel' USSR, 1960.

60-31753 Soviet Agriculture No. 18: Selected Translations on Farm Machinery Plants. September 1960, 16 pages, 50 cents. Translations of Mashinostroitel' USSR, 1960.

60-31754 Soviet Agriculture No. 19: Selected Translations on Farm Machinery Plants. September 1960, 7 pages, 50 cents. Translation of Mashinostroitel' USSR, 1960.

60-31755 Soviet Agriculture No. 20: Selected Translations on Krasnyy Akasy Farm Machinery Plant. September 1960, 6 pages, 50 cents. Translation of Mashinostroitel' USSR, 1960.

60-31692 Soviet Agriculture No. 24: Selected Translations on Farm Machinery Production. August 1960, 17 pages, 50 cents. Translation of Partiynaya Zhizn' USSR 1960 and Mashinostroitel' USSR, 1960.

(Continued on page 138)

Housing and Construction in the USSR

J. Robert Dodge
Fellow ASAE

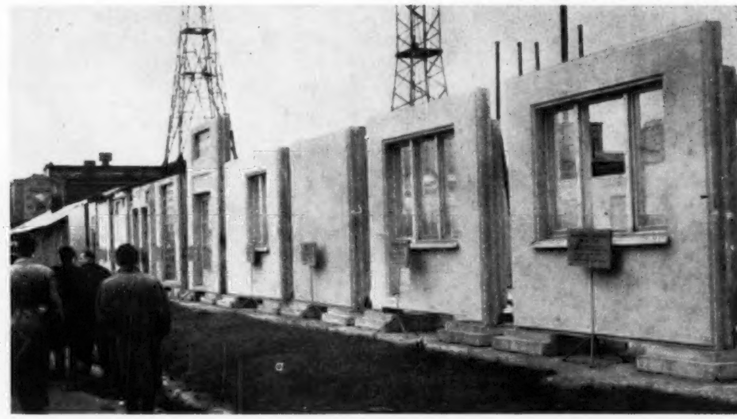

Fig. 1 A Leningrad factory displays the various types of prefabricated concrete wall panels it produces

THE author participated in a twelve-day study tour of housing in the Soviet Union in June and July, 1959, as a member of the United States delegation to the housing committee of the United Nations Economic Commission for Europe. The government of the USSR was our host, and as a result our group, consisting of about forty delegates from various European countries and the United States, had the opportunity to talk to the top government officials concerned with housing and construction, including Premier Khrushchev. In addition, we were able to visit plants producing construction materials and components as well as housing projects in Kiev, Leningrad, and Moscow.

For years housing construction in the USSR failed to keep pace with the growth in urban population. It is estimated that in 1923 urban dwellings had an average of 2.6 persons per room. By 1950 overcrowding had increased to the point where there were over four persons per room*. In 1957 the average Soviet urban dweller had to be content with about five square meters of living space although the norm established as the minimum compatible with healthful conditions was nine square meters per person. One of the new three-room apartments we visited in Leningrad was occupied by three families totaling eleven persons.

In 1957 the construction rate for urban dwellings began to rise substantially, and in 1958 they produced a total of 2,664,000 dwelling units. This is roughly twice the number units that the United States has been building annually in recent years. However, it must be remembered that the average size of the Russian dwelling is about half that of the average American house. At the extraordinary 21st Congress of the Communist Party in 1959, it was revealed that during the seven years ending in 1965 the Soviets plan to build 15,000,000 one-family flats and about seven million rural houses.

In order to produce urban housing at an accelerated rate and still not make excessive demands on the skilled labor force and the building materials industry, the Soviets have taken certain steps, as follows:

They have wholeheartedly embraced standardization not only of building materials and components but of types and sizes of dwellings, and even the arrangements of rooms in dwelling units.

They are industrializing their dwelling construction to the maximum extent possible.

In addition, the sizes of apartments are also standardized. With some exceptions, the Soviets are now building three sizes of apartments and these according to "type" plans. Using the European room count, these are:

One-room apartments consisting of combined living, dining, and sleeping room with small kitchen and a bath

Two-room apartments consisting of combined living-dining room, one bedroom, kitchen and bath

Three-room apartments consisting of combined living-dining room, two bedrooms, kitchen and bath.

The average areas of the apartments now being built appear to range from about 30 to 45 square meters of "living space." ("Living space" is the net area of rooms or other space used for living, dining, and sleeping; it does not include the areas of the kitchen and bath or of halls or vestibules.) This means roughly 40 to 60 square meters of total area per apartment or an average of about 535 sq ft.

The majority of these new dwellings will be in buildings containing up to about 80 apartments. Most of the new buildings seem to be 4 or 5-story "walk-ups" or 8-story

Report presented at the Winter Meeting of the American Society of Agricultural Engineers at Memphis, Tenn., December 1960, on a program arranged by the Farm Structures Division.

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*Parkins, Maurice F. "Housing Behind the Iron Curtain," Journal of Housing, April 1959.

Fig. 2 These 5-story walk-ups in Moscow are built of large prefabricated blocks of bricks

Fig. 3 Playground in a Kiev "neighborhood unit." The buildings are 5-story walk-ups

Fig. 5 Prefabricated concrete wall panels are set in a place at a housing project in Kiev

elevator apartments (Fig. 2). Many are built in projects called "neighborhood units" which contain shops, schools, nurseries, theaters, and cultural centers, all within easy walking distance. Play areas are also provided for children (Fig. 3).

Because of the shortage of skilled workmen, it was found essential to design and prefabricate all elements of the buildings so that they could be assembled on the job without modification and with a minimum of skilled labor.

This has lead to the widespread use of two or three types of prefabricated construction. One of these is a wall-bearing structure in which the walls consist of an assembly of large blocks made up of bricks laid up in mortar in a factory. These blocks may vary in length but are roughly one-third story high, and 12 to 24 in. thick depending on the location of the building and the need for minimizing heat loss. These are handled by cranes with special clamps (Fig. 4). The second method also involves load-bearing walls and partitions (Fig. 5), but in this case the walls are reinforced concrete panels each the size of one wall of a room. These vary in thickness; some with hollow or insulated cores are as much as 19.5 in. thick. Interior partitions are similar to the exterior panels. A third method involves the use of a reinforced concrete interior frame with load-bearing exterior walls. The partitions are prefabricated, non-load bearing reinforced concrete panels. All panels are put in place on the site with tower cranes.

In all the types of construction described above, the floors and roofs are normally of prefabricated, reinforced

Fig. 4 Large, factory assembled blocks of bricks are used to lay up the walls of an apartment house in Kiev

concrete slabs although we saw some wood frame roofs. These slabs were usually ribbed or had hollow cores to reduce weight and were very similar to some of our precast concrete floor systems. The chief differences were that the Russian panels were generally larger. Some of the floor slabs are prestressed concrete.

In addition to floor and roof slabs, the stairs and stair landings are also prefabricated of reinforced concrete, and in one Leningrad factory we saw complete bathroom units being prefabricated. The walls and floors of these units were reinforced concrete. The piping was cast in the panels and the fixtures installed in the factory. This latter did not appear to offer any advantage since toilet bowls were sometimes broken in handling the bathroom units

Another of the elements of buildings which were prefabricated was the wall footings. This again did not appear to be justified because of the necessity for having a very level bed on which to lay the sections. The reason given for factory casting of the footings was to eliminate mixing concrete on the job.

The factories we visited, which produced the reinforced concrete panels and other elements, appeared to be very efficient. In a typical factory in Leningrad, the forms for the panels were mounted on conveyors in a horizontal position, frames for windows or doors were set in place and concrete, which was mixed at the top of the plant and flowed by gravity to the casting floor, was released on signal from a girl who controls the operations on the casting floor from a console. Panels were vibrated, finished and conveyed through steam curing chambers and emerged ready for use. Similarly, the proportioning of the materials for each batch of concrete and the time of mixing was controlled electronically by a girl at a console on the mixing floor. Sand and gravel and cement were stored in silos and fed to the mixer by conveyors. This particular factory was 200 meters long with three casting lines. The mixing plant produced 220,000 cubic meters of finished concrete a year. The wall panels were finished in the factory which included glazing the sash. Roof slabs had two plies of built-up roofing ap-

(Continued on page 140)

Electrical Ground-Water Prospecting

D. F. Witherspoon
Member ASAE

Application of the electrical resistivity method of subsurface investigation

As ground-water storage is more intensively used and the search for additional supplies is undertaken, an increased use will be made of geophysical methods of subsurface investigation. One of these which offers the most promise in ground-water prospecting is the electrical resistivity method. By this method the apparent electrical resistivity variation with depth is determined. Interpretation of the results allows the delineation of layers of different resistivity. This information can be correlated with the water-bearing properties of each layer. Indications may be obtained of particle size, hydraulic conductivity, and salt content of the water in the pores.

The method uses four electrodes on the surface of the soil. A known current is applied to two electrodes and the potential drop is measured across the other two electrodes. From this information the apparent resistivity is determined.

Review of Literature

Wenner (5)* was the first in North America to set forth the theory of resistivity determination of the earth. Gish and Rooney (1) further developed the application of the theory with respect to earth currents and their effect on communications. These investigations led to the development of the Wenner configuration of four electrodes equally spaced. In Europe (4) the electrical resistivity method developed also toward a four-electrode configuration in which the potential electrodes are kept at a constant separation while the current electrodes are moved apart. This method was developed by C. Schlumberger of La Compagnie General de Geophysique.

Theory

The electrical resistivity method is based upon Ohm's Law:

$$R=\frac{V}{I} \qquad [1]$$

where R is the resistance in ohms, V is the electromotive force in volts, and I is the current in amperes.

For a conductor such as a wire, we may write

$$R=\rho\ L/A \qquad [2]$$

where A is the cross sectional area, L is the length, and ρ is the resistivity or resistance between parallel faces of a unit cube of material. By equating [1] and [2], equation [3] is obtained:

Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at Amherst, Mass., August 1960.

The author — D. F. Witherspoon — is assistant professor, department of engineering science, Ontario Agricultural College, Guelph, Ontario, Canada.

Acknowledgment: The author wishes to thank J. D. Lacey for his suggestions in the preparation of this paper.

*Numbers in parentheses refer to the appended references.

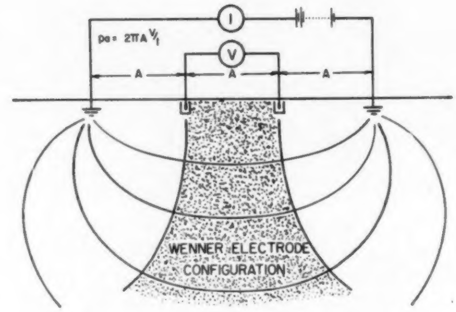

Fig. 1 The Wenner configuration of electrodes

$$\rho=\frac{VA}{IL} \qquad [3]$$

Equation [3] gives the resistivity of a body in terms of voltage drop across a unit volume, the current applied and the dimensions of cross-sectional area and length. This then is a definition of the term resistivity and the units used are ohm-feet. The Wenner configuration of electrodes is shown in Fig. 1. Assuming the potential distribution about a point on the surface of an infinite homogeneous conductor is a hemisphere, the apparent resistivity is

$$\rho=\frac{2\pi\ a\ V}{I} \qquad [4]$$

This then gives the average resistivity or apparent resistivity in terms of the measurable quantities: the electrode spacing, a, the potential difference, V, between the potential electrodes, and the current, I, applied.

The Schlumberger configuration of electrodes is shown in Fig. 2. Similarly the equation for the apparent resistivity determined by the Schlumberger configuration is

$$\rho a=\pi\left\{\frac{(L/2)^2-(a/2)^2}{a}\right\}\left\{\frac{V}{I}\right\} \qquad [5]$$

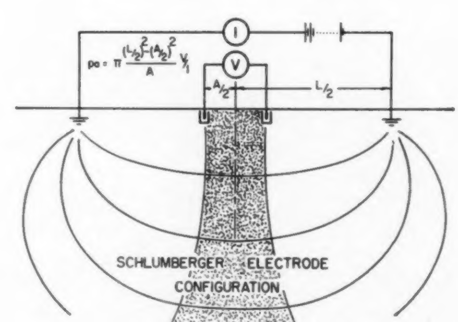

Fig. 2 The Schlumberger configuration of electrodes

In this case the potential electrodes are kept at a constant spacing, *a,* and the current electrode spacing is gradually increased. This method has the following advantages over the Wenner configuration:

Higher speed of operation

Less moving of the potential electrodes and less polarization effects

Better resolving power.

The Schlumberger method seems to find very little use in North America where the Wenner configuration is widely used. However, it is widely used in Europe, and because of its advantage of faster field operation, it is the method used by the author. In the remainder of this paper, the discussion will concern the Schlumberger method.

Equipment

The equipment for making the necessary field measurements is as follows:

Direct-current power source

Ammeter

Direct-current voltmeter

Controls

Wire reels

Current electrodes (two required)

Non-polarizing potential electrodes (two required).

The power source used by the author is a direct-current to direct-current power converter with an input of 12 volts and an output of 120 volts.

A direct-current ammeter is connected in series with the power supply to the current electrodes. A multirange meter is used to allow measurement over a large range of subsurface conditions.

A direct-current electronic voltmeter is used for voltage measurement across the potential electrodes.

Switches are provided in the controls for polarity reversal so that polarization of electrodes is minimized. In conjunction with the controls an earth compensating circuit is provided. This circuit is used to nullify any natural earth potentials so that measurements are made only of the potential difference due to the applied voltage.

In addition to the measuring equipment, wire and electrodes are necessary for earth contact. Four reels of wire are required. In the method described here, two reels are used for the current electrode extension wires, each equal to half the maximum traverse length. The two potential electrode extension wire reels have a capacity of roughly one-tenth the current electrode reel capacity.

The current electrodes are made of steel rods conical in shape with an auger flight attached. This permits ease of insertion in the soil and good soil contact.

The potential electrodes are porous unglazed clay pots. These are filled with a saturated solution of copper sulphate in which a chemically pure copper electrode is inserted. These electrodes are buried in the soil 4 to 6 inches. The use of these electrodes reduces polarization which affects the potential measurements.

Field Operation

A straight line traverse is laid out on a level area with stations symmetrically spaced logarithmically on either side of center. Potential electrode and current electrode stations are distinctively marked.

A party of four is required. The party leader and one other make the necessary current and potential observations and perform calculations. The remaining two men move the current electrodes. An experienced field party can complete two traverses of 4,000 feet in a day using the Schlumberger configuration of electrodes.

Interpretation

Interpretation of results from electrical resistivity measurements is done by the use of model ρ-$L/2$ curves. The curves have been calculated assuming various resistivity contrasts and layer thickness. Most published curves are for horizontal 2-, 3-, 4- and 5-layer cases. La Compagnie Generale de Geophysique (2) and Mooney and Wetzel (3) have published catalogues for the Schlumberger configuration and the Wenner configuration, respectively.

By comparison of the field curves and the model curves, layers of different resistivity and thickness can be distinguished. These indicated layers are correlated with data from nearby wells and borings so that a qualitative evaluation of the resistivity measurements may be made.

Fig. 3 shows a plotting of a field curve obtained near Guelph, Ontario, and its resulting interpretation. The interpretation shows a layer of 810 ohm-ft resistivity to 16 ft, a layer of resistivity 510 ohm-ft from 16 to 20 ft, a layer of resistivity of 420 ohm-ft to 47 ft followed by layers of 1800 ohm-ft to 94 ft and 6600 ohm-ft resistivity. This interpretation gives a good correlation with the nearby well log shown at the top of Fig. 3.

Discussion

The electrical resistivity method has many applications in subsurface investigation and has advantages over other geophysical methods in water supply investigations. The most important advantage is the relatively small investment in equipment ($1,000 to $1,500). Faster field operation allows a large area to be covered in a relatively short time.

Resistivity measurements cannot always be interpreted. The resistivity of a formation depends upon its porosity, degree of saturation of the pores with water, salinity of

(Continued on page 138)

ELECTRICAL SOUNDING DATA

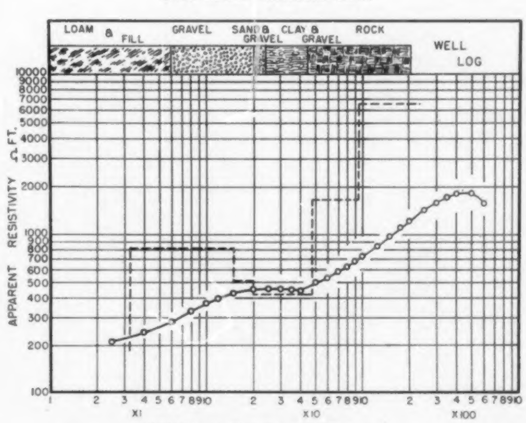

Fig. 3 Plot of field curve (solid line) and its resulting interpretation (broken line)

Soil Moisture Measurement Improved

New plaster of paris blocks prove more accurate and sensitive

George J. Bouyoucos

THE plaster of paris moisture blocks were first proposed in 1940 (1, 2)*. Their purpose is to measure soil moisture electrically, under field conditions, and to serve as a scientific guide to irrigation practices.

The original blocks are adequately sensitive to moisture changes at the drier end of the scale or irrigation levels, but not sufficiently sensitive in the neighborhood of field capacity or wetter. They do show sensitivity in the wet region, but this sensitivity is not very pronounced.

It is the purpose of this paper to discuss the new plaster of paris blocks which are more sensitive in the wetter region than the original blocks.

This increased sensitivity is accomplished simply by increasing the pore space in the blocks. By using 80 to 100 percent of water in the plaster mixture (32 to 40 cc of water to 40 g plaster of paris), both the pore space and the sensitivity of the blocks are increased. When water in the pores is replaced by air, the electrical resistance is tremendously affected. In the original blocks the water in the plaster mixture varied from 50 to 66 percent. The water-holding power of blocks made with 100 percent water is 57 percent, while those with 66 percent water is 32 percent, based on air-dry conditions.

Admittedly, these more sensitive blocks should have been introduced originally especially since they were known. However, at the beginning, the factor of durability or longevity of the blocks in the soil was of dominant consideration (1). Blocks made with 50 percent water in the mixture last longer in the soil than blocks made with 100 percent water. Therefore, sensitivity was sacrificed for durability.

It is the advent of the nylon resin treatment (3) that makes possible now the use of the sensitive blocks. The nylon resin treatment has been of tremendous benefit in the longevity of the plaster of paris blocks in the soil. Blocks made with 80 percent water in the mixture and treated with nylon resin last much longer than blocks made with 50 percent water but not treated with nylon resin. Therefore, all the new sensitive blocks are nylon treated.†

The new sensitive blocks contain several additional improvements over the original blocks. *(a)* Among these are the screen electrodes are now placed parallel to the long surface; previously, they were placed perpendicularly. The parallel position, although more difficult for exact spacing, helps to eliminate the "stray currents." *(b)* A method has been developed for spacing the electrodes exactly ¼ in. apart in all the blocks. *(c)* The blocks are subjected to moist curing for 10 days immediately after setting.

The combination, therefore, of high water ratio, parallel position of the electrodes, exact spacing of the electrodes and prolonged moist curing, go to make the new plaster of paris blocks the most sensitive and accurate thus far made.

Finally, of all the materials that can be used to make soil-moisture measuring blocks, the pure plaster of paris (pure gypsum) still proves to be the best and most practical material (4).

Experimental Results

Table 1 illustrates the sensitivity of the new blocks in terms of soil moisture tension. This study was conducted indoors, in a typical loam soil which was contained in a metal vessel eight inches deep and twelve inches in diameter. A mercury tensiometer was employed. Care was taken to place the blocks in the soil in proper relationship to the tensiometer cup. Only distilled water was used. The electrical resistance readings were measured with the soil mois-

TABLE 1. COMPARING SENSITIVITY OF NEW PLASTER OF PARIS BLOCKS WITH SOIL MOISTURE TENSION OR SUCTION METHOD

Block made with 100 percent water in the mixture		Block made with 80 percent water in the mixture	
Electrical resistance at 70 F, ohms	Moisture tension at 70 F, mm Hg	Electrical resistance at 70 F, ohms	Moisture tension at 70 F, mm Hg
230	0	270	−3
235	18	300	12
235	42	300	77
250	74	300	95
255	102	300	114
260	125	310	150
275	146	350	215
305	174	380	252
340	207	425	280
460	278	495	330
520	306	580	382
720	370	645	420
930	432	705	450
1440	548	840	510
1670	592	900	540
1800	642	1060	595
2090	660	1380	700
2450	700	1500	737
2550	715	1600	750
2670	728		
2750	742		

An Instrument News Contribution from the Department of Soil Science, Michigan State University. Authorized for publication by the director of the Michigan Agricultural Experiment Station, East Lansing, Mich., as Journal Article No. 2728. Articles on agricultural applications of instruments and controls and related problems are invited by the ASAE Committee on Instrumentation and Controls, and should be submitted direct to Karl H. Norris, instrument news editor, 105A South Wing, Administration Bldg., Plant Industry Station, Beltsville, Md.

The author — GEORGE J. BOUYOUCOS — is professor emeritus of Soil Science, Michigan State University, East Lansing.

*Numbers in parentheses refer to the appended references.

†The nylon resin treatment is patented.

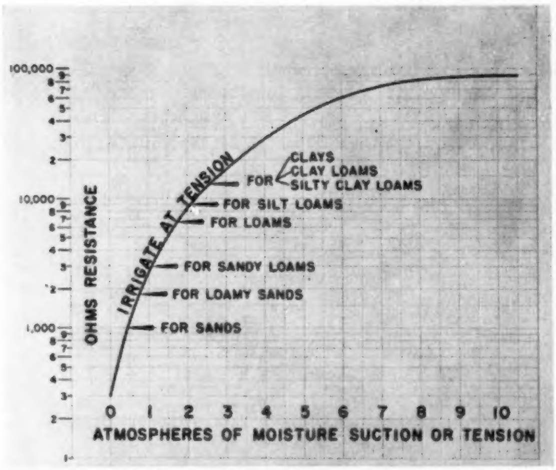

Fig. 1 Calibration in terms of atmospheres of soil moisture tension or suction

ture Wheatstone bridge (1). Both the tensiometer and electrical resistance values were taken when the temperature of the soil at a depth of 3 in. was 70 F.

Table 1 shows the results of blocks made with 100 percent and 80 percent of water in the mixture. The results reveal that the blocks with 100 percent water begin to manifest sensitivity at about 75 mm of tension, or near saturation. At this tension, the electrical resistance is 250 ohms. This resistance increases rapidly and pronouncedly as the soil dries. When a tension of 742 mm is reached, the resistance is 2750 ohms.

As would be expected, the blocks with 80 percent water are slightly less sensitive. Their sensitivity commences at 150 mm tension. At this tension the electrical resistance is 310 ohms. This resistance continues to climb at a pronounced rate as the soil dries. At the tension of 750 mm, the electrical resistance is 1600 ohms which is equivalent to 63 percent of available water on the new calibration (Fig. 2).

As already stated, the original blocks, or those made with 50 and 66 percent of water in the mixture, do begin to reveal sensitivity at field capacity or at 250 to 300 mm tension. But this sensitivity is sluggish and does not increase pronouncedly as the soil dries until a tension of about 500 mm is reached (5).

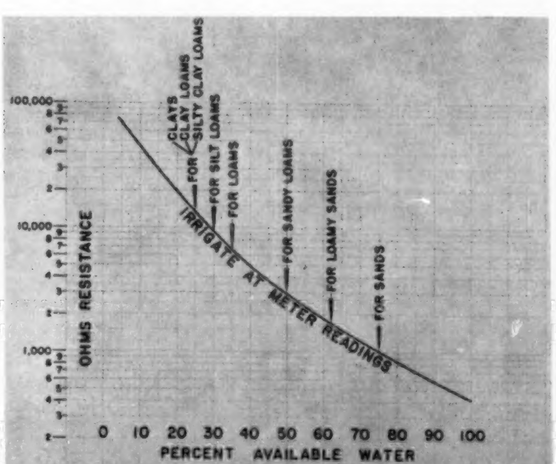

Fig. 2 Calibration in terms of percentage of available soil moisture

The block that has been chosen for future general use is the one that is made in the ratio of 40 g of plaster to 32 cc of water or 80 percent of water. Although this block is somewhat less sensitive than the one with 100 percent water, it is more practical. It has sufficient sensitivity, being sensitive even in the saturation region, and it will last longer in the soil. In comparison with the original block (66 percent) this new sensitive block (80 percent) will last just as long, when both blocks are treated with nylon resin.

A significant fact about these new sensitive blocks is that they measure soil moisture even in pure sands which the original blocks failed to do.

Calibration of the Sensitive Blocks

Fig. 1 shows a calibration of the new blocks (80 percent water) in terms of atmospheres of soil moisture tension or suction using the pressuure membrane technique† of Richards (6).

Fig. 2 shows a calibration of the new blocks (80 percent water) in terms of percentage of available soil moisture (1, 5, 8, 9).

Due to the factors of water release and water reserve, both of which vary in the different textured soils, the two charts also indicate the respective points at which irrigation may be practiced for the respective types of soil. Relative to salt and temperature effects, the same rules that apply to the original blocks (5, 10, 11, 12) also apply to the new sensitive blocks.

Moisture Meter

Two measuring instruments are used with the plaster of paris block method: the soil moisture Wheatstone bridge and the practical soil moisture meter (7).

The meter has undergone considerable redesign and improvement. In its latest form (Fig. 3), the meter is hermetically sealed so as to be moisture and humidity proof and dust proof. The newest type of mercury cells are used

†In connection with the pressure membrane measurements, the author gratefully acknowledges the assistance of Dr. A. Earl Erickson and his technician, James Lockwood, soil science department, Michigan State University.

Fig. 3 Improved soil moisture meter

. . . Soil Moisture Measurement

for exceptionally long life. These are also kept in sealed battery compartments and accessible without moving the instrument from case. The calibration on the scale has been made more exact and has wider spacing at the wet region.

Summary

New sensitive plaster of paris blocks are offered for measuring soil moisture. These blocks can reveal changes in soil moisture at as low a moisture tension as 75 mm of mercury.

The sensitivity of these blocks is accomplished simply by increasing their pore space. This is attained by using higher ratio of water to plaster of paris.

The new blocks have their electrodes placed parallel to the long surface. By a special technique the electrodes are spaced exactly at ¼ in. apart for all blocks. By prolonged moist curing and by nylon resin treatment, these sensitive blocks are as durable as the original nylon-treated blocks.

These new blocks are considered to be the most sensitive and accurate thus far made.

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. . . Ground-Water Prospecting

(Continued from page 135)

water in the pores, and shape of pores. Different layers can only be distinguished from one another if one of the above parameters varies. It can be readily seen that different materials may have the same resistivity. For example, a sand saturated with saline water may have a resistivity equal to a clay, or a gravel or sand of high resistivity may have the same resistivity as rock.

Naturally, since this disadvantage of the method exists no fixed rules can be made regarding the relationship of apparent resistivity to geologic material. The method is most easily used where there are alternate layers of high and low resistivity. It is very useful in tracing strata and in locating additional borings so that the maximum information concerning underlying structures may be obtained.

Some applications in water-supply prospecting are as follows:

(a) Determination of the depth of bedrock or the impermeable base
(b) Determination of the shape of alluvial fills
(c) Determination of the water table in coarse sediments with a small capillary rise
(d) Determination of the depth and thickness of layers of clay or loam in the environment of sand, provided that the clay layers are not too thin as compared to the depth of sand
(e) Determination of the fresh-salt water boundary in coastal areas
(f) Determination of the variation of salinity of the pore water in a formation.
(g) Determination of the porosity, provided the salinity does not obscure resistivity contrasts caused by differences in porosity
(h) Location of faults and shear zones.

The limitations of the resistivity method in ground-water prospecting should be considered at all times. However, use of the resistivity method will increase the knowledge of subsurface formations and aid in the maximum utilization of ground-water supplies.

Summary

The measurement of the electrical resistivity of the earth is useful in determining various properties of the subsurface layers. The Schlumberger configuration of electrodes for resistivity measurement has distinct advantages over the Wenner configuration in field operation. By application of the resistivity method to ground water prospecting increased knowledge of the subsurface stratum will allow better use to be made of ground water supplies.

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. . . Russian Farm Machinery Literature

(Continued from page 131)

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Further information may be obtained by writing to: Publications and Public Information Division, OTS, U.S. Department of Commerce, Washington 25, D.C.

. . . Value of Differential Locks

(Continued from page 127)

tractor with the high slippage level had not used the recommended auxiliary cast weights due to fear of excessive soil compaction.

In both of the cases where slippage exceeded 15 percent, some of the soil was sandy and the tires were on rims of only 28 in. diameter.

Slippage difference is plotted against wheel static weight difference in Fig. 9. In actual plowing, some additional weight and weight difference would result by weight transfer from the tractor front wheels and from plow reaction. This accounted for the respective curves being about 10, 30, and 120 lb to the left of zero on the graph. Theoretically, all these curves should have passed through the zero point. Presumably 10 lb premium was transferred to the left wheel in plowing the moist soil with a two-bottom plow. More weight apparently was transferred to the land wheel as the soil became drier and when the larger plow was used.

Fig. 10 shows wheel slippage as a function of wheel weight. Again, the weights used are static ones, since actual weight transfer was not measured. The coefficient of traction was assumed to remain constant as weight was added. Indeterminate factors may have affected reduced slippage or greater tractive effort as weight was increased. Here again the simplifications have given approximate values.

The reduced effect of weight on slippage in the moist soil, as indicated by the most horizontal curve, may be due to shear-type traction rather than frictional traction. For a given wheel weight, more slippage was recorded for three-bottom plowing than for two-bottom plowing.

The plotted points on this and the previous graph are averages of several test readings for each condition.

The slippage-weight curves for plowing the moist soil were almost the same for both wheels. This indicated similar coefficients of traction on the land and the furrow. The right wheel had less slippage for lower weight levels when plowing in dry soil. Therefore, a better coefficient of traction existed, or more shear-type traction was obtained on the moist furrow bottom than on the dry land surface, until the tire cleats broke through the soil surface, reaching tractive conditions equivalent to that on the furrow bottom.

The theoretical weight equivalent of a locked differential was 205 lb for our test tractor. This was based on the assumption of equal coefficient of traction for each wheel, as was true in many of these tests when the tire cleats protruded through the soil surface layer. One full ring of regular-duty, rear-wheel-weight segments, or 360 lb, was at least equivalent to the locked differential in balancing wheel slippage in these field tests. This allowed for some variation in the coefficient of traction.

Conclusions

In review, the following statements summarize the significant results:

1 Wheel braking appeared as effective as the locked differential in causing the tractor to pass through limited areas of extremely poor traction, where spin-out occurred. Slippage in these areas was 30 percent or more, exceeding that normally practical for field work.

2 A locked differential was equivalent to less than 360 lb of cast iron weight on the left wheel for equalizing drive-wheel traction in these slippage tests while plowing.

3 Without added weight, drive-wheel slippage differences did not exceed 1.5 percent when below the 15 percent slippage level and 5.5 percent when below the 25 percent maximum power level. A maximum difference of 8.7 percent was observed just below the spin-out level of 35 percent left-wheel slippage.

4 Wheel slippage difference appeared to be a straight line function of wheel weight difference in given conditions.

5 Wheel slippage appeared to be a straight line inverse function of total wheel weight in given conditions.

Summary

A differential lock may meet acceptance if the extra cost is reasonable. It is generally known to farmers that, in plowing, land wheels slip more than the furrow wheels unless they have added weight. However, most farmers do not realize that the differences in slippage between the drive wheels are usually quite small.

Tractors are presently sold in Europe with differential locks as standard or optional equipment. The availability of this equipment on imports in the United States and Canada and on one U.S. tractor will provide some measure of domestic interest.

One potential safety hazard with some differential-lock designs is the possibility of the operator failing to disengage the lock before reaching a turn.

Our results indicate that a differential lock is of little value in normal field operation, at least in most conditions

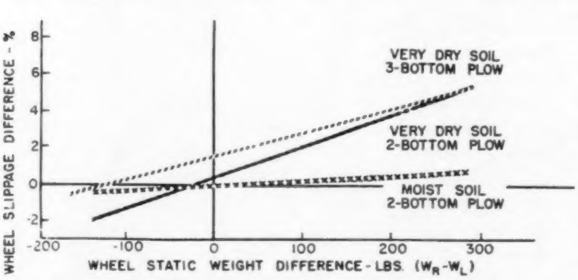

Fig. 9 Wheel-slippage difference vs. difference in wheel static weight when plowing weedy, year-old, corn-stalk-covered clay and sandy soil of different moisture contents, using different sizes of mounted plows

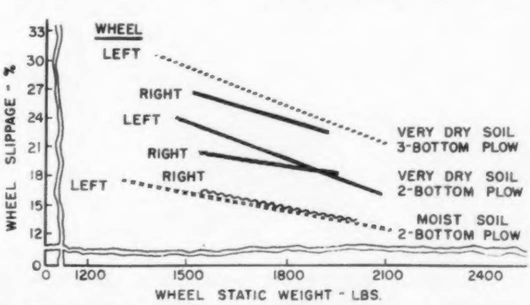

Fig. 10 Wheel slippage vs. wheel static weight when plowing weedy, year-old, corn-stalk-covered clay and sandy soil of different moisture contents, using different sizes of mounted plows

in the United States. A little added weight on the land wheel is equivalent to the lock in equalizing wheel slippage in common field conditions. While compaction due to added weight should not be overlooked, it should be noted that the extra weight in general balances the weight distribution of the two drive wheels in plowing by bringing the land wheel weight up to the furrow wheel weight.

The other major deterrent to the differential lock is the essentially equivalent effect of braking for sustaining motion through intermittent areas of poor tractive conditions, providing sufficient engine power is available to offset the brake power loss. Brakes, of course, are already available as standard equipment for such use. The trend is to larger tractors which should have more reserve power available to meet this emergency.

In brief, the benefits of a differential lock appear to be matched by low-cost readily available cast weights for normal plowing and by wheel braking for limited severe tractive conditions.

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. . . Housing in USSR

(Continued from page 133)

plied at the factory. After being set in place on the site, the joints were grouted and three more plies of built-up roofing were applied.

The terms used in connection with the housing construction in the USSR are a little surprising. In some operations a "factory" produces the various building elements in accordance with the standards in effect at the time and in quantities called for by the particular project. The factory then "sells" them to a "contractor" who in turn erects the building for the "owner". Actually, the state is the designer, the producer of the parts, the contractor who erects them, and the owner. However, the Soviets admitted that in the past, when jobs were behind schedule, it was difficult to pin the responsibility for the failure to complete work on time, since each would blame the other. In order to minimize "buck passing," the Soviets are now eliminating the so-called "contractor" and putting the responsibility on a single organization called "Kombinat" which must not only produce the elements but also erect the buildings. The Leningrad factory described earlier was actually a "Kombinat." However, the organization supplying the raw materials, cement, sand, gravel, and reinforcing steel windows, doors, etc., is still separate.

The foregoing discussion might lead one to believe that the entire house building industry in the USSR is industrialized. This is not true. However, according to Soviet officials, the amount of industrialized construction is increasing very rapidly. Prior to the war about 20 percent of a brick dwelling unit consisted of factory fabricated elements. Today in Moscow about 75 percent of such a structure is assembled from prefabricated elements.

According to the Soviets, the most economical method of construction for urban dwellings is that using large precast concrete panels. In Kiev, projects using the large brick blocks for walls and precast concrete floors and roof panels and precast concrete stairs still appear to outnumber those with precast concrete wall panels. However, we were told that the latter will eventually supersede the prefabricated brick construction. In Leningrad, on the other hand, conventional construction still appears to predominate. In 1952 large blocks or large panel construction accounted for only about 15 percent of dwelling construction. By 1965 about 65 percent of all dwelling construction will be industrialized.

The Soviets are experimenting with even larger assemblies. In Kiev we were shown designs for apartment houses in which entire rooms could be prefabricated and set in place like building blocks either with large cranes or helicopters. They claim to have successfully constructed experimental buildings using this method although we did not see them.

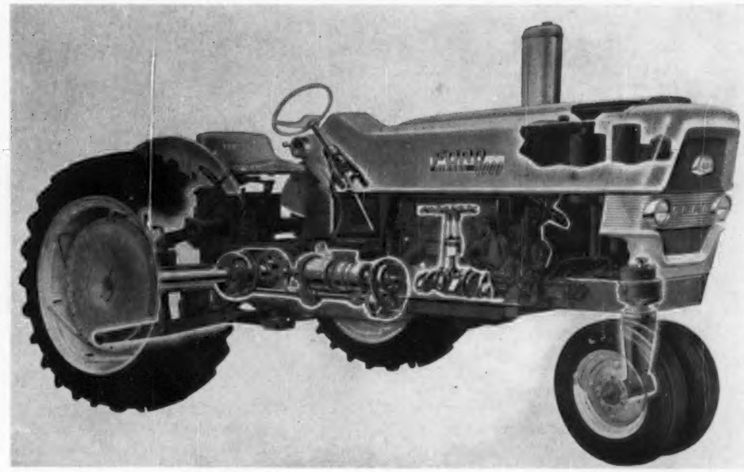
The Soviets are experimenting with foamed concrete and with various light-weight aggregates including slag burned clay. They are also producing a material similar to foam glass to be used as an insulating core in wall panels. In Kiev one of the factories was producing very crude precast gypsum panels to be used as interior partitions. Ceramic tile is produced and used in some cases as a surfacing material for concrete panels and the usual brick, structural clay tile, and concrete block are among their other building materials. All windows, doors, and frames seem to be of wood although we saw some experimental plastic sash and frames at an exhibit in Kiev.

While we did not see any single-family houses under construction, some few are apparently built on the fringes of cities — many by self-help methods. Single-family houses also predominate in rural areas. In addition, they claim to be prefabricating single-family houses for erection in rural villages and on collective farms. We were shown some model houses erected at the exhibitions of economic achievement in Kiev and Moscow. These were simple wood or masonry structures, most of them with three rooms. Some had no plumbing or other equipment.

In respect to quality of construction, appearance of structures was very crude and exterior paint was admittedly of poor quality. We saw no evidence of maintenance following original construction. The Russians readily admitted that they simply could not afford to worry about appearances at this time.

Most kitchens that we saw were equipped with a small sink with no drainboard and a small gas range, smaller than our apartment-type ranges. Only in a few obviously de luxe apartments were there kitchen cabinets, at least some of which were made in Finland. Some of these latter apartments also had stainless steel or aluminum sinks. If families could afford a refrigerator, they furnished it themselves. Bathrooms were usually equipped with a shower and small lavatory. The very old-fashioned water closets with high tanks were usually in a separate compartment. The new apartment houses are centrally heated. On the whole, the apartments did not present our idea of a good appearance on close examination, although it is only fair to say that both buildings and grounds were very clean. The Russians readily admitted that they simply could not afford to worry about appearances at this time.

Ford Unveils 5-Plow Diesel Tractor



"EFFICIENT BIGNESS" are the two words used by Merritt D. Hill, vice-president and general manager of Tractor and Implement Division, Ford Motor Co., and member of ASAE, to describe the company's newest diesel farm tractor — the "6000"— during its introduction recently. He revealed that five years of work and more than 20 million dollars have gone into the development, testing and tooling for manufacture of the most powerful and the largest tractor the company has ever built. The power plant is a new 6-cylinder diesel engine developed and manufactured by Ford for the new tractor. Engine specifications include 3.62-in. bore, 3.9-in. stroke, 242-cu-in. displacement and 16.5 to 1 compression ratio. The engine is rated by the manufacturer at 85 bare engine bhp, 66 PTO hp and 60 dhp. Drawbar pull is rated at 7000 lb.

The tractor has a wheelbase of 95 in. and an over-all length of 149 in. Three front-axle options are available — two-wheel wide adjustable axle, two-wheel row crop assembly and single wheel row crop assembly.

The tractor's new hydraulic power accumulator system, called "Powr-Stor," is described as a new era in hydraulics.

The accumulator tank contains a free piston which separates a volume of an inert gas from varying quantities of hydraulic oil. Oil quantity varies as it is pumped from the tractor's reservoir to the accumulator during periods of low hydraulic power demand and returned to the reservoir when power is needed. As oil enters the accumulator, through an automatic valve, the gas creates hydraulic energy by exerting pressure upon the piston to compress the oil. The increasing oil supply exerts its own pressure upon the piston to compress the gas. The combined gas and oil pressures generate an oil pressure within the tank of about 2,300 psi. Falling pressure triggers the automatic valve to allow the pump to reload the accumulator. There, oil is stored in high volume under high pressure until peak hydraulic power demands re-open the valve for the oil's release and use. This feature is said to reduce as much as two-thirds the engine horsepower normally required to run an adequate size hydraulic oil pump.

A three-point rear implement linkage is an integral part of the new tractor. However, the tractor's implement control and depth penetration functions have been moved from the top link to the two lower links. The method of operating and controlling implements from the operator's seat remains the same as in other company models.

Safety has been emphasized in engineering and design. Side step plates have been designed for safe mounting while a tapered hood provides maximum visibility. With operator comfort and convenience in mind engineers developed a two-position steering wheel, which can be placed in one position when driver is seated, and easily tilted without relinquishing control to a more nearly horizontal position when he wishes to stand. Not to be outdone by the aircraft industry, designers of the new tractor developed the electro-luminescent instrument panel lighting in which instrument dials glow from electric current with no bright lights to distract the operator at night.

Implements immediately available for use with the new tractor include a 5-bottom mounted plow, 5-bottom semi-mounted plow, 3-bottom 2-way plow, mounted 6-row drill planters, 4-row pull-type drill planters, tool bar mounted unit planters, and 6-row front and rear mounted cultivators.

ASAE figured prominently when five former U.S. Secretaries of Agriculture appeared together in a non-political discussion of the nation's agriculture at Michigan State University February 1, during Farmers' week. Shown above are Ezra Taft Benson *(left)*, Honorary Member of ASAE (1957), and Claude R. Wickard *(right)*, Honorary Member of ASAE (1945), with A. W. Farrall *(center)*, candidate for President-Elect of ASAE, who was in charge of arrangements for the event. ASAE members, R. L. Maddex and R. G. Pfister, also served on the arrangements committee.

The theme of the forum was "Agriculture in an Uneasy World". The five secretaries, whose combined length of service in that office stretch from 1933 to 1961, are: Henry A. Wallace, and Claude R. Wickard, who served in the Roosevelt administration; Clinton P. Anderson, and Charles F. Brannan, the Truman administration, and Ezra Taft Benson, the Eisenhower administration. They make up one-third of the 15 persons who have served as Secretary of Agriculture since the agricultural department commissioner became a member of the President's cabinet in 1889.

Minneapolis-Moline Becomes Motec Industries

Stockholders of Minneapolis-Moline Co. approved a change in the corporation's name to Motec Industries, Inc. at the annual meeting, February 21. The name change, Edmund F. Buryan, president, said, was made so that the corporate name would reflect the diversified activities now characteristic of the company. The traditional name of Minneapolis-Moline will continue to be associated with the Farm Equipment Division. The following divisions will be maintained: Minneapolis-Moline Farm Equipment; Mobilift Materials Handling Equipment; Mopower Construction Equipment; Molectronics; Mohawk Foundry and Machine; Moline Automotive; Motec Engineering; Motec International; Mocraft Power Tool; and Pioneer Equipment Finance Co.

Farm Materials Handling Exposition

A Farm Materials Handling Exposition, sponsored by Wisconsin Public Service Corp. in conjunction with the University of Wisconsin County Agricultural Extension Service, will be held at the Brown County Veterans Memorial Arena, Green Bay, Wis., April 5 and 6. The show will feature the latest equipment and methods for incorporating labor saving, time saving, and efficiency into handling, storing, and processing of farm materials and products. More than 50 manufacturers and distributors are expected to display over 100 items of equipment. Further details may be obtained by writing to: Keith Hawks, farm sales supervisor, Wisconsin Public Service Corp., Green Bay, Wis.

Caterpillar Acquires French Subsidiary

Caterpillar Tractor Co. has announced that the manufacturing plant of its new subsidiary, Caterpillar France S. A., is located in Grenoble, France. The subsidiary has purchased a 150,000-sq ft facility from Groupe Richier, a French manufacturer of cranes, road rollers, cement mixers, and crawler tractors. W. J. Bornholdt, president of the subsidiary, said production of Caterpillar D4 tractors is scheduled to begin in March. Later, the plant will also manufacture 955 Traxcavators. It employs about 350 people.

Solid State Mechanics Course

The Pennsylvania State University has announced that a course on Solid State Mechanics will be conducted by PSU College of Engineering and Architecture, department of engineering mechanics, June 11 to 23. The course is planned for research, design, and materials engineers in industrial, governmental, and educational institutions. Further details may be obtained by writing to: Dr. Joseph Marin, professor and head of the department of engineering mechanics at the University.

New Bearing Publication

SKF Industries, Inc. has announced the inaugural issue of *Motion Research and Engineering*, devoted to news and information on research, development and production in the field of rolling contact bearings and their application to the art and science of motion engineering. It is available without charge to engineers, research and development personnel and management, production, and purchasing executives throughout industry. Requests may be directed to SKF Industries, Inc., Front St. and Erie Ave., Philadelphia 32, Pa.

AE PRESENTED TO OTHER GROUPS

(Left) Buildings and Equipment Session speakers at the third Agricultural Industries Forum, which was held January 31 and February 1 on the University of Illinois campus, Urbana, met before morning session to go over the slides to be presented during the conference. Businessmen from agricultural industries and outstanding farmers were able to discuss the particulars of farmstead planning and financing with: *(Left to right)* R. C. Morrow (ASAE member), A. O. Smith Corp., Kankakee, Ill.; J. F. Green, vice-president, Commercial National Bank, Peoria, Ill.; R. M. Moore, Moore Farm Buildings Co., Charleston, Ill.; and J. E. Wills, University of Illinois farm management economist.

(Right) W. L. Kjelgaard, research engineer, Pennsylvania State University, and R. W. Kleis, head, agricultural engineering department, University of Massachusetts (ASAE members) participated in the speaking program at the annual Dairy Farmers' Seminar held at the University of Massachusetts, January 25 and 26. W. L. Kjelgaard spoke on points on hay drying, with and without heat, and R. W. Kleis spoke on merits of various harvesting methods and equipment. Pictured left to right are: Kjelgaard; R. C. Foley, professor of dairy and animal science, University of Massachusetts; and Kleis.

Engineering Summer Conferences

A total of 27 Engineering Summer Conferences will be held at the University of Michigan during 1961. Lectures will be presented by outstanding men from industrial and government laboratories, as well as from the University of Michigan and other universities. In addition to lectures, course time is assigned to discussion and work sessions, laboratory work, and demonstration when indicated. Courses range from technical writing to underground storage of natural gas. Further information may be obtained by writing to: Engineering Summer Conferences, 126B West Engineering Building, University of Michigan, Ann Arbor, Mich.

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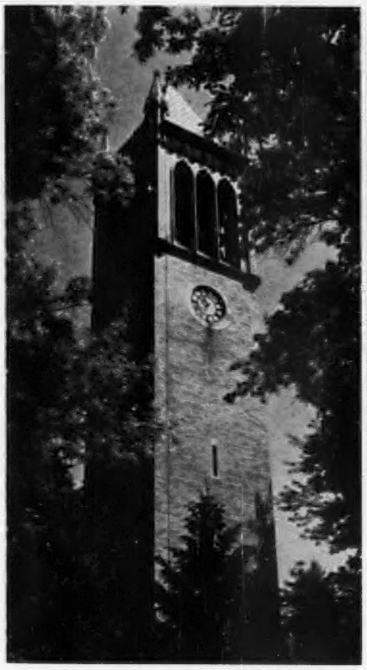
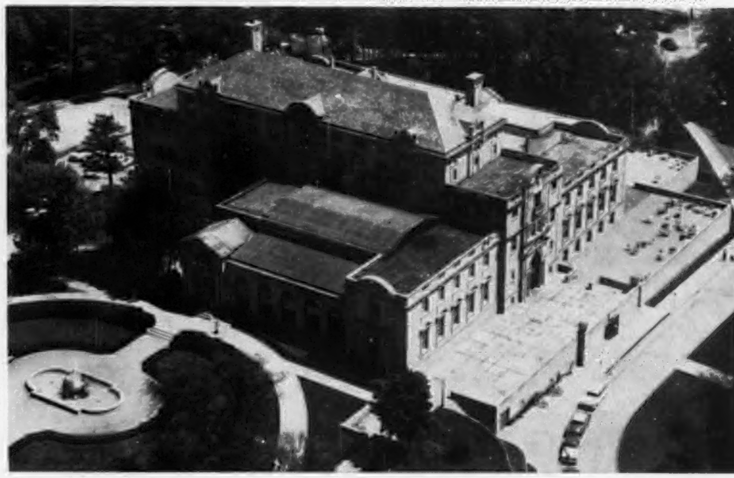


Twice daily visitors will hear Iowa State University's carillon from the campus campanile



Headquarters for the 54th Annual ASAE meeting will be the air-conditioned ISU Memorial Union. Food, lodging, a browsing library and many other activities are available in the Union Building.

ASAE Annual Meeting Returns to Ames After 30 Years

BACK in June, 1931, a handful of agricultural engineers discussed rubber tires on tractors and other "newfangled" mechanical devices during the Annual ASAE meeting held in Ames, Iowa. This year, 30 years later, June 25 to 28, more than 800 engineers are expected to return to the Iowa State University campus in the heart of a highly-mechanized farm belt for the Society's 54th Annual Meeting.

The occasion offers an excellent opportunity to combine Society activities with a family-planned vacation without the usual hurry and worry. Comprehensive programs are being arranged for family activities as well as special functions for women and children.

While technical sessions and committee meetings are in progress, wives will have an opportunity to tour the Atomic Energy Institute, the well-known College of Home Economics, a Guatamalan shop, the Des Moines Art Center and the Salisbury House — a mansion resplendent in early Iowa aristocracy. In addition there will be luncheons, informal card games, and get-acquainted chats.

A special effort has been made to provide entertainment for children. Youngsters between three and six years of age will be under the care of trained child development graduates and a trained nurse. Lunches will be provided. Bowling, swimming, golf, a dance, and games are scheduled for children over seven years old. A square dance, dinner-dance, and chicken barbeque are scheduled at times when men can participate. Iowa State's beautiful — and tough — golf course will be inviting to golf enthusiasts.

Five dormitories are being prepared for housing at the rate of $2.50 per person per day. One building will be reserved exclusively for families, three for couples without children, and another for single men. These dormitories are equipped with recreation rooms, television, washers, driers, telephones, and enclosed showers and toilets. In addition many motels are located near the campus.

Much emphasis is being placed this year on student branch activities. Meetings are being arranged to assist student members in making business and professional contacts. Student rates will be in effect for housing and registration during the four-day session.

The Iowa State University is urging engineers, wives, children and students to "Aim for Ames in '61."

. . . News

(Continued from page 142)

Bendix to Make Simms Diesel Units

An agreement whereby The Bendix Corp. will market and manufacture diesel fuel injection equipment of Simms Motor Units Ltd., of England, in the United States was announced recently. The broadened product line reportedly will include the small and medium-size diesels for which Simms multi-cylinder fuel injection systems are designed, as well as the high-horsepower types utilizing Bendix single-cylinder injection units. The British firm's equipment will be handled in the United States by the same distributor and service station organization handling Bendix fuel injection equipment.

Symposium on Poultry Health Change Noted

The Symposium on Poultry Health, sponsored by the U.S. Department of Agriculture, and scheduled previously at the University of Georgia, Athens, has been changed to the USDA's Jefferson Auditorium, South Building, Washington, D. C., March 20 to 22.

The symposium is planned primarily for research workers and scientists concerned with poultry health. However, there is also widespread interest among both producers and consumers, because of the increasing importance of poultry meats and other products in the nation's food supply. The program will include discussions of the role of USDA, other public agencies, and industry in producing wholesome poultry and poultry products.

EVENTS CALENDAR

March 20-22 — *Symposium on Poultry Health,* Jefferson Auditorium, USDA South Bldg., Washington, D. C. Sponsored by USDA. Information may be obtained by writing to: R. G. Yeck, Livestock Engineering and Farm Structures Research Branch, (AERD, ARS) USDA, Beltsville, Md.

March 22-23 — *Farm Materials Handling Field Days,* sponsored by Wisconsin Power and Light Co., Wisconsin Electric Power Co., and Madison Gas and Electric Co., in conjunction with Successful Farming Magazine. For additional information contact Wayne Russell, rural promotion supervisor, Wisconsin Power and Light Co., Madison, Wis.

(Continued on page 156)

Southeast Section

The Southeast Section held its annual meeting on February 6, 7, and 8 at the Robert E. Lee and Heidelberg Hotels, in Jackson, Miss., in conjunction with the Association of Southern Agricultural Workers. The three-day meeting opened with a general session on Monday morning, at which F. A. Kummer, head, agricultural engineering department, Auburn University, spoke on future challenges of agricultural engineering in education; W. M. Bruce, chief, harvesting and farm processing research branch, AERD, USDA, spoke on openings for agricultural engineers in government; and E. F. Schneider, vice-president, International Harvester Co., spoke on engineering faces the challenges of tomorrow's agriculture. A general session for ASAW also was held Monday morning. Two concurrent sessions were held on Monday afternoon. Included on a Farm Structures program were presentations on concrete footings and slab design; exterior latex paints; color and treatment of asphalt shingle roofing as they affect attic air and ceiling panel surface temperature in homes; effect of broiler house design on rate of broiler gain; and a new approach in low cost plastic greenhouses. A joint session of the ASAE Soil and Water and the Soil Conservation Section of ASAW was also held on Monday afternoon, at which the following topics were discussed: Interrelationships of Highways and Agricultural Drainage and Erosion Control; Improved Management Reduces Soil and Water Losses; Rain Fall Simulation Studies at Watkinsville; Establishing Vegetative Cover on Floor Retarding Structures in Louisiana; Estimating Soil Losses in the South; and Highway Erosion Control.

General Sessions for both ASAE and ASAW were held on Tuesday morning. The ASAE program included an address by E. T. Swink, head, agricultural engineering department, Virginia Polytechnic Institute, on the subject "Presenting the Agricultural Engineering Challenge to High School Students," and one by L. W. Hurlbut, ASAE President and chairman, department of agricultural engineering, University of Nebraska, on the topic "Challenges of Agricultural Engineers." The theme for the Electric Power and Processing session, held on Tuesday afternoon, was "Research in Increased Poultry Production." Papers were given in line with this theme on an electronic flow meter for milk lines; environmental research facilities for poultry; vacuum system for removal of lungs and other waste products from broilers; heat transfer potentials in poultry processing plants; and a ventilating system for cage laying houses. The theme for the papers presented during the Power and Machinery session on Tuesday afternoon was "Today's Technology and Its Relationship to Agriculture." A joint session of Farm Structures and Electric Power and Processing held Wednesday morning covered feeding, harvesting, curing, storing, loading, and drying of agricultural products. A joint Power and Machinery and Soil and Water program covered the roll of chemicals and mechanized application in today's agriculture.

Mid-Central Section

The Mid-Central Section will hold its annual meeting on April 7 and 8 at the Hotel Robidoux, St. Joseph, Mo. The technical program will begin on Friday afternoon with six concurrent sessions. The traditional bowling competition will take place at 4:00 p.m. on Friday. The annual banquet is scheduled for Friday evening, at which ASAE President L. W. Hurlbut will be the featured speaker. His topic will be "Challenges to Agricultural Engineers." Bowling trophies and the student paper plaque will also be presented at the banquet. The business meeting will be held on Saturday morning as well as a technical program at which six papers will be presented. Officers will be installed at the Saturday noon luncheon. John H. Wessman of the Grain Processing Machinery Manufacturers Association will address the group at this luncheon on the opportunity for agricultural engineers in the grain processing and feed industry.

ASAE MEETINGS CALENDAR

March 22 — CONNECTICUT VALLEY SECTION, Carville's Motor Court, Hatrford, Conn.

March 30-31 — PACIFIC COAST SECTION, University of California, Davis.

April 7-8 — MID-CENTRAL SECTION, Robidoux Hotel, St. Joseph, Mo.

April 14—WASHINGTON, D.C. - MARYLAND SECTION, USDA South Bldg., Washington, D.C.

April 14-15 — ROCKY MOUNTAIN SECTION, University of Wyoming, Laramie.

April 14-15 — SOUTHWEST SECTION, Grim Hotel, Texarkana, Texas.

April 20-21 — ALABAMA SECTION, Collins Hotel, Jasper, Ala.

April 28-29 — OHIO SECTION, Secor Hotel, Toledo, Ohio

May 18-20 — FLORIDA SECTION, Daytona Plaza Hotel, Daytona Beach, Fla.

June 25-28—ANNUAL MEETING, Iowa State University, Ames, Ia.

August 20-23—NORTH ATLANTIC SECTION, University of New Brunswick, Fredericton, N. B., Canada.

December 12-15 — WINTER MEETING, Palmer House, Chicago, Ill.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

Alabama Section

The Alabama Section will hold its spring meeting April 20 and 21 at the Collins Hotel, Jasper, Ala. Highlights will include tours of the Pillsbury feedmill, the Lewis Smith Dam, and the Southern Electric Generating Company's coal mine. A banquet is scheduled for the evening of April 20 at the Country Club.

Rocky Mountain Section

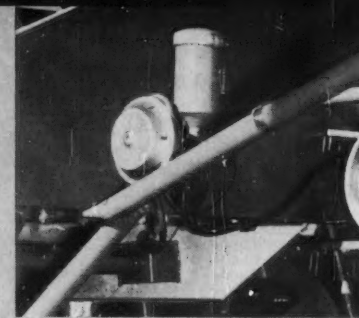
The Rocky Mountain Section will hold its annual meeting on April 14 and 15 at the University of Wyoming, Laramie. The tentative program is as follows: "Some Challenges for Agricultural Engineers," by ASAE President L. W. Hurlbut; "Buildings for Profitable Farmsteads," by D. W. Richter, Armco Drainage and Metal Products, Inc.; "The National Tillage Ma-

(Continued on page 154)

The Lilliston Implement Co., Albany, Ga., provides $300 annually for prize awards in the Southeast Section Student Paper Contest. This year first prize of $150 was awarded to Robert E. Boyer, a senior in agricultural engineering at the University of Kentucky, shown receiving the award from William G. Moore of the Lilliston Implement Co. The winning paper entitled "Supplemental Lighting for Winter Growth of Plants" was prepared by Mr. Boyer for one of his classes in agricultural engineering

Three of the newly elected officers of the Southeast Section chat with the banquet speaker, J. O. Emmerich, editor of Jackson State Times and editor and publisher of McComb Enterprise Journal, at the Southeast Section annual meeting, held February 6 to 8. Shown left to right are: F. M. Shy (sales engineer, Republic Steel Corp.), first vice-chairman; Emmerich; G. W. Moore (chief engineer, Lilliston Implement Co.), second vice-chairman; and R. K. Smith (specialist in rural electrification, Mississippi Agricultural Extension Service), secretary-treasurer.

Simple push of control-panel button instantly lubricates both combine and grain header or corn head while operating. Panel light flashes when lube job is completed.



Multi-Luber pump delivers refinery-pure lubricant under high pressure through feeder lines to individual bearings.

Downtime for hand-lubricating of farm implements — normally 30 minutes to one hour per day — cuts into daily yield, adds to crop cost.

Ford and other leading manufacturers are "designing out" this costly method, "designing in" central power lubrication that makes possible greater daily production . . . as much as two to four extra acres of wheat per day! Any operator is sure to favor equipment that completes his harvest faster and gives better protection to his machinery while doing it.

Ford combine with Lincoln Multi-Luber® provides . . .

MORE TIME FOR FARMING!

Lincoln's Multi-Luber System is now available as factory-installed optional equipment on the Ford Series 611 Self-Propelled Combine.

Write today for your copy of the new brochure, "Multi-Luber Power Lubrication Systems for Farm Implements and Machinery".

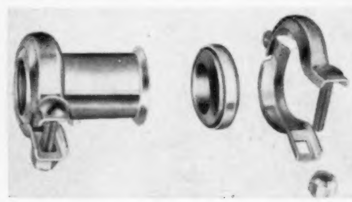
LINCOLN

ENGINEERING COMPANY

[illegible] Goodfellow Blvd., [illegible] Louis 20, Mo. — Division of the [illegible]

New Design Pipe Coupling

Marman Div., Aeroquip Corp., 11214 Exposition Blvd., Los Angeles 64, Calif., has introduced a newly designed pipe



coupling now available in a wide range of standard pipe sizes from ⅜ to 4 in. and in lengths from 2 to 36 in. Design provides for the gasket to be fully contained in the gasket retainer, a feature said to allow uniform pressure of the gasket against the pipe and sleeve. Joints can be supplied in either cadmium plated steel or with a black painted finish and are designed to join plain pipe ends without cutting or threading the pipe. According to the manufacturer, the new joints allow up to 4-deg angular misalignment, permit both angular and axial pipe movement without leakage, and meet ASA requirements for 150-lb service with temperatures from −40 F to +250 F. Special gaskets suitable for higher temperatures are available on special request.

New 4-Cylinder Diesel Tractors

International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., has begun production of a new 4-cylinder diesel engine

for its International and Farmall 340 tractors. The new 4-cylinder power plant, built specifically for the company's 340 series tractors, is said to furnish 40 hp at the PTO and an estimated 36 hp at the drawbar. Many parts of the new D-166 engine are identical and interchangeable with parts in the 6-cylinder D-282 and D-236 engines now used in the company's larger tractors.

Individual glow plugs in each pre-combustion chamber, single-rotor fuel pump, pintle-type self-cleaning injection nozzles and low friction pistons are featured in the new engine.

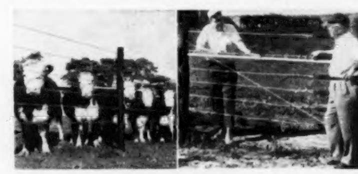
Sheller Attachment for Pickers

Tractor and Implement Division, Ford Motor Co., Birmingham, Mich., has introduced a sheller unit to use with its two-row

corn pickers or harvesters. The new unit is available with a frame, wagon delivery auger and other parts, and can be installed at the farm. When mounted as a substitute for the corn picker husking bed, or in place of the cross conveyor of the harvester, it converts either machine into a picker-sheller.

New Cattle Feedlot Fence System

American Steel & Wire Division, United States Steel Corp., 525 William Penn Place, Pittsburgh 30, Pa., has developed a new

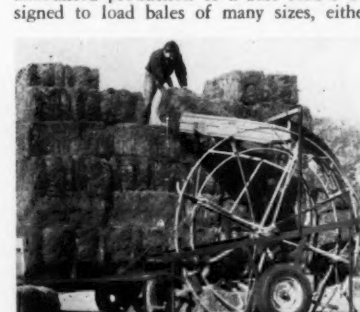


cattle feedlot fence system described to be inexpensive and highly efficient.

The new type of feedlot fence system combines steel cable, heavy duty springs and steel or pressure-creosoted posts. Requiring no special building tools, steel cable is strung through the posts. Extension springs, used at end and corner posts prevent the cable from sagging and give the fence flexibility when cattle crowd against it. The end-corner assembly of the system is supported by a horizontal steel brace and a diagonal tension brace. Features include maximum air flow in feeding area, and minimum shade area in feedlots. These factors hasten drying of a feeding area following rain and reduce drifting snow. Shown at right, examining an installation, are ASAE members P.G. Strom, *(far right)*, and T. L. Willrich, extension agricultural engineer for Iowa State University.

"Ferris Wheel" Bale Loader

Welch Mfg., Inc., Herington, Kans., has announced production of a bale loader designed to load bales of many sizes, either



round or square. Resembling a ferris wheel, the new bale loader can be attached to a truck or trailer by a simple hitch which can

be changed from field position to transport position, ready to tow behind car or truck.

In operation, runners guide each bale into the throat of the loader. A star wheel on each runner is designed to prevent round bales from rolling ahead of the machine. Spring tension holds the chute down for picking up bales in growing hay. Descriptive literature is available on request from the manufacturer.

35-Hp Row-Crop Tractor Added to Line

Deere & Co., 3300 River Dr., Moline, Ill., has introduced a new row-crop utility tractor in the 35-hp size. The new model in

the 1010 Series features a low profile, low center of gravity, and wide front axle for good stability for hillside operations. It has full 20-in. crop clearance despite its height of 56 in. at hoodline. The new tractor is available with 4-cylinder gasoline or diesel engine with a 5-speed sliding-gear transmission and ground speeds up to 17½ mph.

Optional features include independent dual-speed (540-1000 rpm) PTO, power-adjusted rear wheels, deluxe seat, power steering, 3-point hitch with load-and-depth control, and up to three hydraulic circuits.

Announces New Insulation for Masonry Walls

Vermiculite Institute, Editorial Dept., 4725 Olson Memorial Highway, Minneapolis 22, Minn., announces a new water-

repellent vermiculite fill for insulating masonry walls. A free-flowing granular material, the new fill can be poured directly into the cores of masonry blocks or the voids of cavity walls, without rodding or tamping.

According to the report, a 12-in. block wall insulated with the new material has a heat transmission (U) value of 0.15, compared with 0.30 for an uninsulated wall. A 4-cu ft bag will fill about 24 sq ft of 2-in. cavity wall construction, or 14 sq ft of 8-in. block construction. The inorganic fill is said to be noncumbustible.

Custom-Engineered Hydraulic Oil

Lubrication Engineers, Inc., 2809 Race St., Fort Worth, Tex., has introduced a new custom-engineered hydraulic oil designed to help insure peak performance from hydraulic systems under extreme operating conditions.

The new product, identified as LE Brand, is said to possess the ability to maintain proper operating viscosity over a wide temperature range; to have high film strength to resist extreme pressures prevalent in hydraulic systems; and possess high resistance to heat, oxidation and foaming, plus the addition of anti-oxidation and anti-foam agents to further insure maximum protection against internal damage to hydraulic systems.

Baling Wire Carton Improves Operations

The Colorado Fuel & Iron Corp., P.O. Box 1920, Denver 1, Colo., has introduced a new baling wire carton, designed to main-

tain the uniform shape of the coil, and permit neat, compact stacking, saving storage space. The carton can be used also as a self-dispenser. A perforated 7½-in. diameter punch out disk is cut on both the top and bottom of the carton. After punching out these disks the carton containing wire may be mounted directly on the baler. Four paper coil ties can be broken by hand through the disk hole. The baler wire will then pay out from the center of the coil through the disk opening.

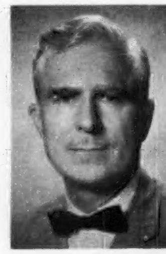
Fiber Glass Tanks for Sprayers

Molded Fiber Glass Body Co., Ashtabula, Ohio, has announced that John Deere has incorporated in its No. 31 and No. 50

sprayers a 200-gal fiber glass reinforced plastic tank. The tank measures 58¾ in. in length and 32 in. in diameter, and weighs only 55 lb. Despite its light weight, the material is rugged and is similar to that used for car and truck bodies, boat hulls, and military planes and missiles. Another feature of the fiber glass tank is its translucency which permits one to see the approximate liquid level at a glance.

According to the manufacturer, the tanks will withstand corrosion from most known fertilizer solutions, most insecticides and pesticides, hydrochloric acid to 50 percent, phosphoric acid, gasoline, xylene, methanol, acetic acid, sulphuric acid to 50 percent, benzoic acid, citric acid, lactic acid, oxalic acid, stearic acid, tannic acid, and most salts of acids.


L. E. Terry


D. M. Kinch


R. B. Hickok


N. T. Odden

LeGrand E. Terry, eastern regional sales manager, Mobile Hydraulics Division, Vickers, Inc., Detroit, Mich., has been transferred to its El Segundo, Calif., plant as western regional sales manager of Mobile products sales.

Donald M. Kinch, chairman, agricultural engineering department, University of Hawaii, Honolulu, is on sabbatical leave to Brazil on a Fulbright grant to lecture and conduct research in farm processing. He will be in Brazil one year and is stationed at Piracicaba, Sao Paulo, where the Agricultural College of the University of Sao Paulo is located.

Robert B. Hickok recently has resumed work in soil and water conservation research with the Watershed Technology Research Branch, Soil and Water Conservation Research Division, USDA, as investigations leader of its national watershed runoff studies program. During the past 4½ years he has been connected with the planning, design and construction of ICBM and IRBM facilities for the U.S. Air Force, Air Research and Development Command, Ballistic Missiles Division, with headquarters in Los Angeles, Calif. For more than 20 years previously, he had been engaged in watershed hydrology research for the USDA.

Norman T. Odden recently has joined the staff of the University of Massachusetts as instructor of agricultural engineering. His work will consist of research and extension in farmstead engineering. He received a B.S. degree in agricultural engineering from Cornell University, and recently completed work for an M.S. degree at Michigan State University.


H. P. Smith


I. F. Reed

Harris P. Smith, ASAE Life Fellow, retired from active service with the Texas A. & M. College in November of last year, after having served in many capacities in the college system for the past 42 years. He was born in Poplarville, Miss., on August 3, 1891, and graduated from the Pearl River County Agricultural High School. He earned a B.S. degree in agriculture with a specialty in agricultural engineering from Mississippi State College in 1917, and an M.S. degree in agricultural engineering in 1926 and a professional degree in agricultural engineering in 1940 from Texas A. & M. College.

Mr. Smith had a leave of absence from the college during 1950 and 1951 to serve on an advisory commission to the Minister of Agriculture in Turkey. In 1956, he accepted a position as chief advisor of the Texas A. & M. Party in East Pakistan. This party was located in Dacca and consisted of 13 people who were A. & M. staff members who offered assistance in education, agricultural engineering, home economics and commerce to the people in East Pakistan through the university system in that country. After completing one two-year tour, he decided that the work was of such value to his country that he would accept a second two-year tour which was completed in September, 1960.

His Book entitled "Farm Machinery and Equipment" is used as a college textbook in this and other countries, and bulletins, circulars, and reports published by him are used as reference material throughout the cotton industry.

He became a member of ASAE in 1920 and was elected to the grade of Life Fellow in 1960. In 1956 he was awarded the Cyrus Hall McCormick Gold Medal by ASAE. He is a registered professional engineer in the state of Texas, a member of Tau Beta Pi, Phi Kappa Phi, and the Brazos Union Lodge 129 AF & AM.

I. F. Reed, agricultural engineer, USDA Tillage Machinery Laboratory, Auburn, Ala., will be in charge of the farm machinery section of the United States exhibit at the International Agricultural Exhibition, which will be held March 21 to April 21 in Cairo, Egypt. He spent three days in Washington, D. C., for briefing before departing for Cairo by chartered flight with other Exhibition staffers. He arrived in Cairo on March 5 to work with exhibit organization and planning before the exhibition begins. He will explain the operation of modern farm equipment to the visitors, as well as present demonstrations with some of the machinery at the exhibition. In addition, he will hold seminars for agricultural engineers at the Alexandria University College of Agriculture. Also, he will explain the work of the Tillage Machinery Laboratory at Auburn, and discuss agricultural engi-

William G. Kaiser Elected Honorary Member

The Council of ASAE recently has elected William G. Kaiser, 23rd president of ASAE, to the grade of Honorary Member in the Society, in recognition of his 47 years of distinguished service to the agricultural engineering profession.


William G. Kaiser

Mr. Kaiser was born June 10, 1887, on a farm in Stephenson County, near Freeport, Ill. Before he was a year old the family moved to O'Brien County, Iowa, where he attended a rural district school and the Sutherland High School. He received a B.S. degree in agricultural engineering from Iowa State University in 1914, and immediately after graduation was appointed agricultural engineer for the Iowa Agricultural Experiment Station. In 1917, he accepted a position as agricultural engineer with the Portland Cement Association, where he remained until his retirement in 1953. Over the years he has worked in several capacities with PCA taking charge of its educational and promotional work for the use of concrete on the farm; organizing a farm building plan service; preparing illustrated articles for the farm press; training personnel for his staff; directing the development of visual teaching aids; and supervising the over-all strategy of the industry's farm extension program. In addition, from 1933 to 1945 he had charge of the association's work for the extension of concrete in dwelling house construction; also the development, improvement and promotion of precast building products. Since retiring, the operation of two farms in Illinois helps him maintain a close contact with agricultural problems, and he is now preparing a technical manual on concrete design.

He has given valuable assistance to farmers, both through publications and through direct service to farmers and educational institutions. A series of bulletins and other publications on use of concrete for which he is largely responsible have been widely used by agricultural engineering departments, and used directly by farmers. He also assisted the Agricultural Engineering Research Division of USDA in preparation of publications and farm building plans involving use of concrete.

He has been an active member of ASAE since joining in 1917, and in addition to serving the Society as president has also been vice-president, councilor, and a member of the nominating committee. He also served the Farm Structures Division as its first chairman, and was a member of the ASAE Advisory Committee to the USDA Agricultural Research Administration.

Also, as an active member of the American Concrete Institute, he served on several of its committees, including one which cooperated with the USDA and state experiment stations in studies of silage pressures and on means of protecting silo walls from attack of silage acids.

Under his chairmanship of an American Society for Testing Materials committee on concrete building units, standard specifications were adopted for both hollow and solid load-bearing block, and for non-load-bearing block. This work is credited with a gratifying degree of standardization in the quality of these building units throughout the country, and as a major impetus to their use, said to be foremost in volume of masonry construction.

neering research in the United States. If time permits, he plans to visit some of Egypt's desert agricultural experiment stations.

Sponsored by the United Arab Republic, the International Agricultural Exhibition will have exhibits from 23 nations, including Russia and Communist China. The U.S. Exhibit is sponsored jointly by the Departments of Agriculture and Commerce with the cooperation of private enterprises serving American farmers and the State Department. With the theme "Power to Produce for Peace," the U.S. Exhibit will portray the story of this nation's agriculture.

F. L. Rimbach, consultant to New England Power Service Co., Clinton, Mass., has been appointed colonel on the military and personal staff to the governor of Massachusetts. This is the third governor of Massachusetts who has so honored Mr. Rimbach.

Leland O. Drew is doing work toward a Ph.D. degree in agricultural engineering at Michigan State University where he is a graduate research assistant in the agricultural engineering department. He formerly was agricultural engineering advisor with International Cooperation Administration.

Richard D. Holdren recently has been assigned to the Harvesting and Farm Processing Branch of the ARS Agricultural Engineering Research Division, at Beltsville, Md. He is a recent graduate of Ohio State University.

Jerry R. Lambert has completed work on an M.S. degree in agricultural engineering at the University of Florida, and is now at North Carolina State College working toward a Ph.D. degree.

NECROLOGY

Ronald C. Holt, a 2nd Lieutenant in the U.S. Air Force, was killed on February 15 in a collision of two Air Force training planes. A native of Illinois, he was born August 9, 1936, at Danville, Ill. He attended grade school at Armstrong and Collison, Ill., and graduated from the Armstrong High School. He received a B.S. degree in 1958 and an M.S. degree in 1960, both in agricultural engineering, from the University of Illinois. Lt. Holt was commissioned from the Air Force ROTC of UI in 1958, and was in training as a flying cadet at Vance Air Force Base, Enid, Okla., at the time of his death. Surviving him is his wife, Corallee.

Abraham J. Sprecher, engineer, design section of the USDA Soil Conservation Service, died on December 8, 1960, at his home in Littleton, Colo. He was born on January 1, 1916, in Houston, Texas. His early years were spent in the east, and he received a B.S. degree in agricultural engineering from Cornell University in 1940. After graduation and until May, 1941, he worked for the U.S. Department of Commerce as a draftsman. In 1941 he joined the USDA Soil Conservation Service at Elbert, Colo., as camp engineer in charge of design and construction of soil conservation structures. From September, 1941, to September, 1945, he was a design engineer for the U.S. Army Air Corps, where he worked on radar charts and maps. After the war he returned to the Soil Conservation Service as district engineer at Kiowa, Colo. He just recently had been promoted to the engineering division of the design section, Soil Conservation Service, at Beltsville, Md. He was to have begun work there December 18, 1960.

He is survived by his wife, Lucille, and one son, David.

Following are brief reviews of papers presented at ASAE meetings or other agricultural engineering papers of which complete copies are available. ASAE members may obtain copies of these papers without charge by returning order forms supplied upon payment of membership dues. Non-members, and members requesting more than 10 copies, may purchase papers at 50 cents each to cover carrying charges from the American Society of Agricultural Engineers, St. Joseph, Mich.

Plastic Greenhouse Design, Heating, and Ventilating, by McNeil Marshall, associate agricultural engineer, Virginia Agricultural Experiment Station, agricultural engineering department, Virginia Polytechnic Institute, Blacksburg, Va. Paper presented at the Annual Meeting of ASAE at Ohio State University, Columbus, June 1960, on a program arranged by the Farm Structures Division. Paper No. **60-426.**

Plastic greenhouses are practical, low-cost structures that compare favorably with glass greenhouses in providing satisfactory environmental conditions for the growth and production of vegetable and flower plants and crops, according to the author. In this paper, he discusses their design, heating requirements and systems, and ventilating systems, as well as plastic films for covering experimental greenhouse structures. Also included, is a summary of the results of the work done in Virginia on the design, heating and ventilating of the plastic greenhouse.

Results of Experiments on Stabilizing Soil That Is to Be Used as a Building Material, by David R. Cannon, engineering advisor, Near East Foundation, New York, N. Y. Technical Report No. 101 of the Housing and Home Finance Agency, Washington 25, D. C. Paper No. **60-24.**

This paper gives the results of experiments conducted over a two-year period on stabilizing soil to be used as building material in the country of Iran. The experiments were conducted with clay and sand, to which was added bitudobe and lime putty, for stabilizing the soil, in making pressed building blocks. The results of these tests are shown in tabulated form in tables included with the paper.

Plans, Pineapples, and Politics, by L. V. Hass, vice-president, Libby, McNeill and Libby. An address before the ASAE Hawaii Section meeting, at Honolulu, Hawaii, October, 1960. Paper No. **60-25.**

This address is a challenge for agricultural engineers, giving a new look at the new role of the agricultural engineer. It gives the background of the pineapple industry; how it has been developed over the past 60 years; its problems today; and its opportunities and challenges for the future.

Design and Development of Ten-Foot Mower, by R. P. Harbage and R. V. Morr, respectively, manager of engineering and product engineer, New Idea Division, Avco Corp., Coldwater, Ohio. Paper presented at a joint meeting of the ASAE Ohio and Michigan Sections, at Toledo, Ohio, April, 1959. Paper No. **60-26.**

The authors point out in this paper that indications for the mower of the future are for high capacity in acres per hour, minimum maintenance, and a very high degree of service reliability. This paper tells how a mower development program is planned with these requirements in mind.

A Study of the Effects of Nozzle Types and Methods of Application on the Control of Certain Cotton Insects, by Lambert H. Wilkes, associate professor, agricultural engineering department, Texas Agricultural Experiment Station, College Station. Paper presented at the Winter Meeting of ASAE at Memphis, Tenn., December 1960, on a program arranged by the Power and Machinery Division. Paper No. **60-603.**

This paper tells of the research conducted cooperatively by the departments of agricultural engineering and entomology, A. & M. College of Texas, with field experiments in the Brazos River Valley near College Station, Texas. As reported in this paper, the objectives of these studies have been to determine the effects of distribution of spray material on the control of cotton insects. Various types of nozzles and methods of application have also been investigated. The author points out that the effectiveness and the results of the applications of spray materials have been measured both by the insect infestation in the fields and by the yields of the cotton. The primary insects encountered in these studies were the boll weevil and the bollworm.

Evaluation of Infiltration Measurements, by Leonard J. Erie, irrigation engineer, Southwest Water Conservation Laboratory, SWCRD, ARS, USDA, Tempe, Ariz. Paper presented at the Winter Meeting of ASAE at Memphis, Tenn., December 1960, on a program arranged by the Soil and Water Division. Paper No. **60-700.**

Development of infiltration data that are representative of an area not only necessitates proper installation and use of equipment but an appreciation of the many factors that affect infiltration. Past studies on these factors are noted in this paper and the most important are itemized. These are discussed in relation to their effect on infiltration and various investigators are quoted. Present day equipment and procedures also are discussed, and emphasis is placed on means of coping with the various influencing factors by proper use of equipment and procedures and intelligent interpretation.

Philosophy of Feedback System, by Henry D. Bowen, associate professor, agricultural engineering department, North Carolina State College, Raleigh. Paper presented at the Winter Meeting of ASAE at Memphis, Tenn., December 1960, on a program arranged by the Electric Power and Processing Division. Paper No. **60-800.**

Agriculture uses the synthesizing capabilities of green plants and warm blooded animals to convert elements and basic compounds into consumer products. The author points out that many of the products now marketed by agriculture can conceivably be synthesized by nonbiological system components, and that in the developing market race one of the factors in competitive abilities of the various industries is the effectiveness of their respective feedback and control systems. The author attempts to explain the general implications of feedback and control theory as it is applied to business, biological systems, industrial production, and where it can and must be put into agricultural systems if they are to become and remain competitive for traditional agricultural markets.

The following bulletins have been released recently. Copies may be obtained by writing to author or institution listed with each.

The following publications are available from the Research Branch, Canada Department of Agriculture, Ottawa, Ontario, Canada:

Influence of Depth of Moist Soil at Seeding Time and of Seasonal Rainfall on Wheat Yields in Southwestern Saskatchewan. Publication 1090. November 1960.

Reclaiming Acid Dome Peat Bogs for Agricultural Use. Publication 1089. October 1960.

1956-1959 Research Report — Entomology Research Institute for Biological Control.

Cattle Guards — Plans Nos. 5752, 5903 and 5904. Miscellaneous Publication No. 831. December 1960. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price 5 cents.

Survey on Power Tiller Manufacture in Taiwan. Plant Industry Series No. 18. June 1960. Chinese-American Joint Commission on Rural Reconstruction, Taipei, Taiwan, China.

Food and Freedom — Gearing U.S. Farm Production to World Plenty and Peace. October 1960. Conference on Economic Progress, 1001 Connecticut Ave., N.W., Washington 6, D.C. One to 9 copies, 50 cents each; 10 to 99 copies, 40 cents each; 100 or more copies, 30 cents each; and 1,000 or more copies, prices on request.

A Tobacco Stripping Room Conditioner, by P. N. Winn, Jr., and G. J. Burkhardt. Bulletin 469. June 1960. Agricultural Experiment Station, University of Maryland, College Park, Md.

Vapor Pressure Determination of Seed Hygroscopicity, by B. C. Haynes, Jr. Technical Bulletin No. 1229, Agricultural Research Service, USDA, University of Georgia Experiment Station. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. Price, 15 cents.

Proceedings of the Ohio Water Management Conference, December, 1960. Department of Natural Resources, Ohio Water Commission, 1562 W. First Ave., Columbus 12, Ohio.

Abstracts of Papers Presented at the Dairy Farmers' Seminar, January, 1961. Department of Dairy and Animal Science, College of Agriculture, University of Massachusetts, Amherst.

Aeration of Grain in Commercial Storages. Marketing Research Report No. 178. Revised November, 1960. Transportation and Facilities Research Division, AMS, USDA, in cooperation with Agricultural Experiment Stations of Georgia, Indiana, Iowa, Kansas, and Texas. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. Price, 35 cents.

Water System and Treatment Hand Book. National Association, Domestic and Farm Pump Manufacturers, Inc., 20 West St., Annapolis, Md.

Scandinavian Research Guide. Volumes I and II. Office of Documentation, National Academy of Sciences, National Research Council, 2101 Constitution Ave., Washington 25, D.C. Price $10.00.

Tobacco Division Progress Report—1954-1958. Catalog No. A56-63. 1958. Information Division, Canada Department of Agriculture, Ottawa, Ontario, Canada.

Ground-Water Flow in Basin Clay Soil and the Determination of Some Hydrological Factors in Relation with the Drainage System, by J. W. Van Hoorn. Summary in English. No. 66.10 in Series — Verslagen van Landbouwkundige Onderzoekingen. PUDOC, Wageningen, Netherlands.

Agricultural Machinery Workshops: Design, Equipment and Management. FAO Agricultural Development Paper No. 66. Columbia University Press, International Documents Service, 2960 Broadway, New York 27, N. Y. Price, $1.00.

The following bulletins are available from the Agricultural Machinery Administration, Province of Saskatchewan, Department of Agriculture, 7th and Hamilton, Regina, Saskatchewan, Canada:

Test Report No. 1160 of Massey-Ferguson Number 10 Baler. January, 1961.

Test Report No. 1260 of Case Model 200 Pickup Baler. January, 1961.

Agricultural and Horticultural Engineering Abstracts. Vol. XI, No. 4, 1960. Scientific Intelligence Unit, National Institute of Agricultural Engineering, Wrest Park, Silsoe, Bedfordshire.

Minor Structures of Some Holocene and Pleistocene Sediments from the Southwestern Part of the Netherlands, by N. A. De Ridder. Institute for Land and Water Management Research, Wageningen, Netherlands.

... With ASAE Sections

(Continued from page 144)

chinery Laboratory," by A. W. Cooper, National Tillage Machinery Laboratory; "Feedlot Mechanization," by E. B. Wilson, Montana State College; "Hydraulics of Sub-Critical Flow in Small Channels," by E. G. Kruse, ARS, USDA; "Clod Problems in Potato Mechanization," by E. N. Davis, Colorado State University; "Some Current Agricultural Engineering Research by USDA," by R. O. Gilden, Federal Extension Service, USDA; "New Uses of Concrete on the Farm," by M. L. Burgener, Portland Cement Association; "New Low Cost Prefabricated Irrigation Structures," by C. E. Israelsen, Utah State University; and "New Low Cost Water Level Recorders," by V. E. Hansen, Utah State University. Student papers will be presented also on unannounced subjects. The banquet speaker will be A. W. Cooper, who will discuss his recent trip to the Soviet Union. He will report on how the people live and how they farm as seen through the eyes of an engineer.

Connecticut Valley Section

The Connecticut Valley Section will hold a meeting at Carville's Motor Court, Hartford, Conn., on March 22. The featured speaker will be Kurt Hain, a German engineer who is visiting professor of mechanical engineering at Yale. His topic will be "Kinematics of Farm Machinery."

Florida Section

The Florida Section will hold its annual meeting on May 18, 19 and 20 at the Daytona Plaza Hotel, Daytona Beach, Fla. It is reported that an interesting and informative program is being planned and that, with the belief "all work and no play makes Jack a dull boy," recreation also will be available at this meeting.

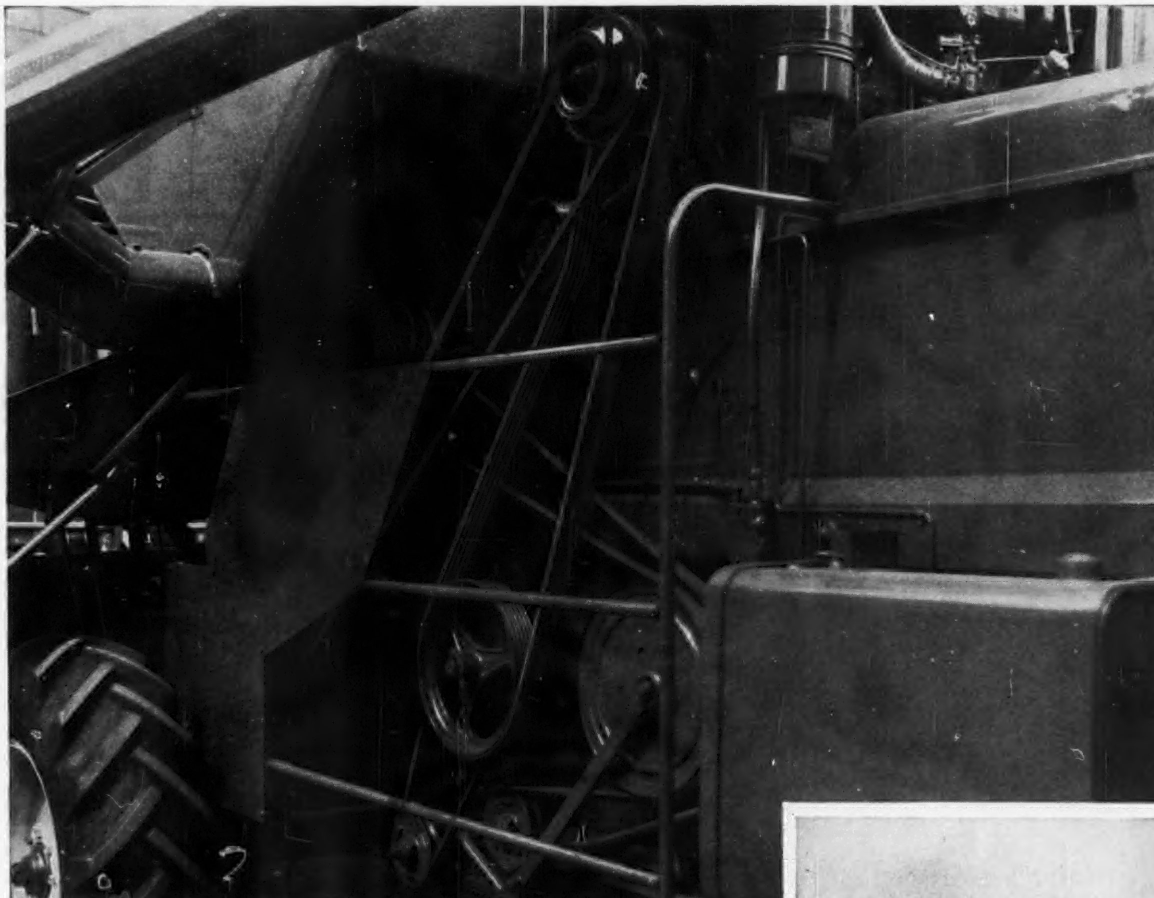
The program will be of interest to workers in the four major fields of activity and tentatively will include papers on some problems in pelleting hay, curing tobacco by the bulk method, watershed progress, progress of mechanization of citrus fruit, refrigeration for perishable produce, and the future outlook for farm machinery dealers.

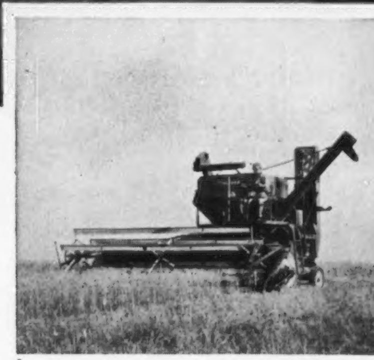
Ohio Section

The Ohio Section will hold its spring meeting on April 28 and 29 at the Secor Hotel, in Toledo, Ohio. The tentative program will include a tour of the Willys Motors plant and facilities on Friday morning, followed by a technical session at the Secor Hotel in the afternoon. A 6:30 dinner also is planned for Friday evening. A technical session is being planned for Saturday morning, followed by the business meeting.

Pacific Coast Section

The Pacific Coast Section will hold its annual meeting at the University of California, Davis, on March 30 and 31. The program will have sessions devoted to consideration of the latest developments in mechanization, irrigation and instrumentation for crop production and processing. A feature of the program will be a panel discussion on California agriculture, labor, and mechanization. Panel members will be Senator James Colby, Louis Rozzoni, president, Farm Bureau, and Harold Rogers, editor of Western Fruit Grower. Roy Bainer, chairman, agricultural engineering department, University of California, will moderate the panel discussion.





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The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Bailey, John C. — Head, special services, Clark Rural Electric Co-op. Corp. (Mail) P.O. Box 57, Winchester, Ky.

Bentzinger, Harlan A. — Chief engr., and production mgr., Precision Chemical Pump Corp., 1396 Main St., Waltham, Mass.

Berry, William E. — Draftsman, John Deere Harvester Wks. (Mail) 928 34th Ave., East Moline, Ill.

Carlson, Guilford E. — Work unit engr., (SCS) USDA. (Mail) 820 Main St., Fort Morgan, Colo.

Carpenter, George W. — Gen. mgr., William Salman Ranch. (Mail) General Delivery, La Cueva, Mora Co., N. M.

Dale, James M. — Construction engr., Engineering and Watershed Planning Unit, (SCS) USDA. (Mail) 2432 Shirley, Fort Worth 9, Texas

Day, Richard L. — Product eng. trainee, John Deere Harvester Wks. (Mail) Box 265, Port Byron, Ill.

Dillon, Max G. — Vice-pres., sales, Twin-Draulic, Inc., 220 Walnut St., Laurens, Iowa

Eaves, J. J. — Chief engr., Taylor Machine Wks., Louisville, Miss.

Eddy, David W. — Field contact engr., Dept. 32-01, AC Spark Plug Div., General Motors Corp., 1300 N. Dort Highway, Flint, Mich.

Engle, Carl J. — Des. engr., Oliver Corp. (Mail) R.R. 1, Box 211, Richland, Mich.

Gray, Robert B. — Sales engr., Western Rain Bird Sales. (Mail) 124 S. San Gabriel Ave., Azusa, Calif.

Haile, Herbert Q. Jr. — Vice-pres.-engr., Able Irrigation Co., P.O. Box 1100, Uvalde, Texas

Halvorson, Arthur E. — Agr. engr., Bur. of Land Management, Dept. of Interior. (Mail) Box 1034, Malta, Mont.

Hartshorn, Robert G. — Mgr., southeastern sales div., Everpure, Inc. (Mail) 4505 19th Ave., West, Bradenton, Fla.

Haws, Frank W. — Res. assoc. in irrigation and agr. eng., Utah State University. (Mail) 47 E. Third South, Logan, Utah

Hayes, John B. — Sr. engr., John Deere Harvester Wks. (Mail) R.R. 3, Milan, Ill.

Helquist, Carl A. — Res. engr., Tractor and Implement Div., Ford Motor Co., 2500 E. Maple Rd., Birmingham, Mich.

Hien, Nguyen G. — Dir., Agr. Machinery Directorate of Agr. Land Dev. Commissariat, Vietnam. (Mail) Agr. Eng. Dept., Iowa State University, Ames, Iowa

Holland, G. H. — Mgr., product planning, Massey-Ferguson, Ltd., 915 King St., W., Toronto 3, Ont., Canada

Hurt, Thomas G. — Power use advisor, Natchez Trace Electric Power Association, Houston, Miss.

Jimenez, Rey J. — Instr. of agr. eng., College of Agr. and Mechanics Arts, University of Puerto Rico, College Station, Mayaguez, Puerto Rico

Johnson, Hjalmar W. — Vice-pres., planning and research, Inland Steel Co. (Mail) Sauk Trail Farm, R.R. 4, Valparaiso, Ind.

Johnson, Walter H. — Staff engr., Liquefied Petroleum Gas Association, 11 S. LaSalle St., Chicago 3, Ill.

Kidd, Malcolm H. — Sr. V-belt engr., Dayton Industrial Products Co., Div. of Dayco Corp., 3155 S. Campbell Ave., Springfield, Mo.

Lumsden, Jesse C., Jr. — Dist. sales engr., Georgia Power Co. (Mail) 1206 Hall Ave., Tifton, Ga.

Merkle, Joe — Area rep., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.

Moore, James B. Jr. — Sales engr., W. R. Ames Co., 1001 S. Dempsay Rd., Milpitas, Calif.

Nelson, Ronald L. — Power use advisor, North Pine Electric Co-op., Inc. (Mail) R.R. 1, Box 55, Sandstone, Minn.

Novak, Joe A. — Retired. (Mail) 414 S. First St., Oskaloosa, Iowa

Parker, Fred H. — Asst. to plans officer, plans branch, Low Altitude Missile Dept., USARADSCH. (Mail) 3208 Kirkcaldy St., El Paso, Texas

Raun, Layton R. — (With the U.S. Air Force) Det. 6, 28th WEARON, APO 125, New York, N. Y.

Renard, Kenneth G. — Hydraulic engr., (SWCRD, ARS) USDA. (Mail) P.O. Box 306, Tombstone, Ariz.

Richard, Harold R. — Area engr., (SCS) USDA. (Mail) 803 Ruth St., Prescott, Ariz.

Schuller, Gerald E. — Territory mgr., John Deere Co. (Mail) 312 Tokay, Modesto, Calif.

Sorenson, Edwin — Sales rep., T. H. Davies & Co., Ltd., P.O. Box 3020, Honolulu, Hawaii

Tran-Van-Nhieu, Jean — Agr. engr., Agr. Machinery Directorate, Land Development of Vietnam, 55 Tran-nhat-Duat, Saigon, South Vietnam

Tupper, Gordon R. — Instr. and jr. agr. engr., agr. eng. dept., University of Arkansas, Fayetteville, Ark.

Vaughan, Donald R.—Pres., Vaughan Manufacturing Inc. (Mail) 731 Second St., Woodland, Calif.

Vokey, Harvey P. — Field rep., Plywood Manufacturers Association of British Columbia. (Mail) 5435 Angers, Montreal 20, Quebec, Canada

Waines, Robert K. — Eng. dept., The Autocall Co. (Mail) R.R. 3, Shelby, Ohio

Wallingford, Otto H. — Owner, B. H. Wallingford Orchards, R.R. 2, Box 181, Auburn, Maine

Warnock, Everett H. — Asst. engr., Allis-Chalmers Mfg. Co. (Mail) 1435 State St., LaCrosse, Wis.

Wilson, Edward B. Jr. — Proj. engr., John Bean Div., Food Machinery & Chemical Co. (Mail) Apt. 3, 1922 Harrison St., Orlando, Fla.

Windham, Jimmy R. — Instr., agr. eng. dept., North Carolina State College, Raleigh, N. C.

TRANSFER OF MEMBERSHIP

Guest, Richard W. — Asst. prof., res. and ext., Cornell University, Riley-Robb Hall, Ithaca, N. Y. (Associate Member to Member)

Hahn, G. LeRoy — Agr. engr., (AERD, ARS) USDA, agr. eng. dept., University of California, Davis, Calif. (Associate Member to Member)

Harris, Wesley L. — Asst. prof., agr. eng. dept., University of Maryland, College Park, Md. (Associate Member to Member)

Irish, Wilmot W. — Ext. agr. engr., agr. eng. dept., Cornell University, Riley-Robb Hall, Ithaca, N. Y. (Associate Member to Member)

Meyer, Calvin J. — Engr., materials eng., John Deere Tractor Res. and Eng. Center, Waterloo, Iowa (Associate Member to Member)

Shute, George — Product planning mgr., tractors, Massey-Ferguson, Ltd., 915 King St., W., Toronto 3, Ont., Canada (Associate Member to Member)

Swearingen, Albert J.—Assoc. agr. engr., agr. eng. ext. section, The University of Tennessee. (Mail) Apt. K, 506 Longview Rd., Knoxville 19, Tenn. (Associate Member to Member)

Thomas, Carl H. — Assoc. prof. in agr. eng., Louisiana State University, Agr. Eng. Bldg., University Station, Baton Rouge 3, La. (Associate Member to Member)

. . . Events Calendar

(Continued from page 143)

March 28-29 — *Fifth Transportation of Perishables Conference,* University of California, Davis. For information write to: Agricultural Extension Information, Division of Agricultural Sciences, University of California, Davis.

March 28-30 — *National Water Research Symposium,* Sheraton-Park Hotel, Washington, D. C. Sponsored by the National Association of Soil Conservation Districts, 1435 G St., N.W., Washington, D. C., and the National Reclamation Association, 14th and F Sts., N.W., Washington 4, D. C.

April 5-6 — *Farm Materials Handling Exposition,* Brown County Veterans Memorial Arena, Green Bay, Wis. Sponsored by Wisconsin Public Service Corp. in conjunction with The University of Wisconsin County Agricultural Extension Service. For details contact: Keith Hawks, farm sales supervisor, Wisconsin Public Service Corp., Green Bay, Wis.

April 11-13 — *American Society of Lubrication Engineers Annual Meeting,* Bellevue-Stratford Hotel, Philadelphia, Pa. Information may be obtained from: ASLE, 5 N. Wabash Ave., Chicago 2, Ill.

April 15-25 — *1961 Swiss Industries Fair,* Basle, Switzerland. Details may be obtained from Consulate General of Switzerland, 75 E. Wacker Dr., Chicago 1, Ill.

April 17-19 — Eighth *National Watershed Congress,* Ramada Inn, Tucson, Ariz. Details may be obtained from The National Association of Soil Conservation Districts, League City, Texas.

April 17-21 — *American Welding Society 42nd Annual Convention,* Commodore Hotel, 42nd St., New York, N. Y. For further details write to Information Center, AWS, 33 W. 39th St., New York 18, N. Y.

April 18-20 — *North Central Regional Extension Agricultural Engineers' Workshop,* Del Prado Hotel, Chicago, Ill. For information write to Arthur H. Schulz, Extension Service, North Dakota University, Fargo, N. D.

April 20-22 — *76th Annual Convention of the Illinois Society of Professional Engineers,* Peoria, Ill. Information may be obtained from ISPE, 1108 East London Ave., Peoria, Ill.

May 1-2 — *The American Zinc Institute Annual Meeting,* Drake Hotel, Chicago, Ill. Details may be obtained from AZI, 324 Ferry St., Lafayette, Ind.

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Look at the seals in this Fafnir Ball Bearing. Notice how the lips press against the inner ring. Not just a touch but firm, positive contact . . . for positive sealing action! *No other built-in seal gives better protection against contaminants!*

And the protection lasts. Fafnir's R-Seal is fabric-reinforced Buna N-rubber. Extra tough . . . long lasting . . . self-compensating for wear!

Millions of Fafnir R-Seal Ball Bearings are in service. They've solved bearing problems on farm and industrial equipment of all kinds. They can solve *your* problems, too!

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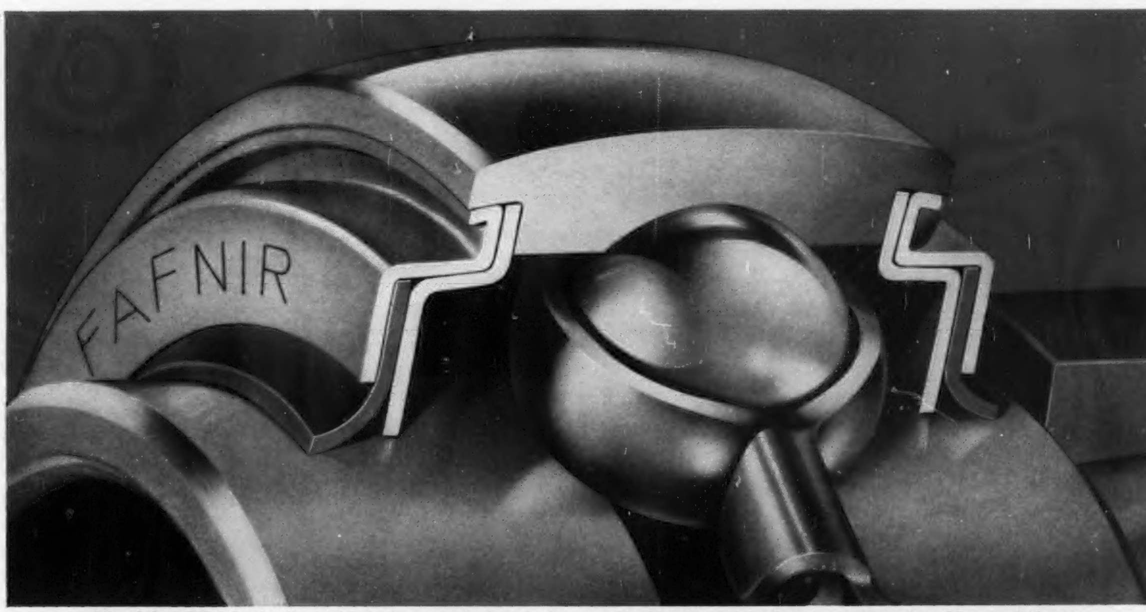
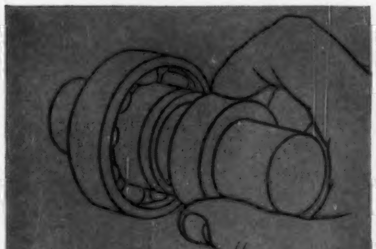


Flared lips of Fafnir Plya-Seals ride in firm, constant contact with ground inner ring O.D. Plya-Seals are rigidly secured.

Steel back-up plates insure proper seal position at all times. Bearings are permanently prelubricated.



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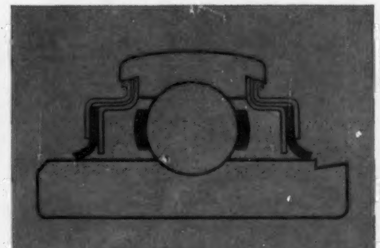

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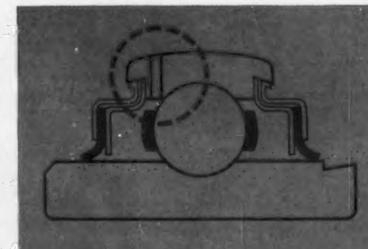

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PERSONNEL SERVICE BULLETIN

PERSONNEL SERVICE BULLETIN

Note: In this bulletin the following listings current and previously reported are not repeated in detail. For further information, see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this bulletin, request form for Personnel Service listing.

Positions Open–(1960) **September**–O-303-627, 303-628, 303-629, 303-630, 273-631, 284-632, 309-634. **October**–O-318-636, 320-637, 322-638, 322-639, 322-640, 325-642, 326-643, 347-645. **November**–O-372-646, 392-647, 393-648. **December**–O-407-649, 425-651, 429-652, 388-653. (1961) **January**–O-434-654, 440-655, 461-656, 465-657, 465-658. **February**–O-11-101, 13-102, 10-103, 35-104, 36-105, 57-106.

Positions Wanted – (1960) **September** – W-274-65, 281-66, 282-67, 283-68, 294-70, 287-73, 297-74, 300-75. **October**–W-305-76, 314-77, 323-78, 328-79. **November**–W-338-80, 377-81, 379-83, 365-84, 376-86, 355-87, 394-88. **December**–W-420-89, 419-90. (1961) **January**–W-431-94, 444-95, 453-96, 468-97. **February**–W-8-1, 21-2, 22-3, 24-4, 29-5, 16-6, 30-7, 34-8.

NEW POSITIONS OPEN

Agricultural Engineer for associate or assistant professor, in an eastern land grant university. Research 60%, teaching 40%, electric power and processing. Major teaching responsibility will be handling graduate courses. Age 27-45. PhD in agricultural engineering, or MS with considerable experience. Teaching and/or research experience. Able to work with people and direct student activities. Usual opportunity for advancement. Salary open. O-67-107

Agricultural Engineer, assistant or associate professor, for research and teaching in irrigation engineering and related areas of water management, in a southwestern state university. Age 25-45. PhD in agricultural or civil engineering. Teaching, research, and/or design experience in soil and water field. Able to work cooperatively with soil and plant scientists. Opportunity to become fully responsible for irrigation work in the department. Position open July 1. Salary, $8,000-$9,000, with 30 days annual leave and opportunity for increase. O-76-108

Agricultural Engineer (assistant) for applied research to improve machinery for cultural and harvesting operations in citrus groves, with state agricultural experiment station. Southern location. Age 25 or over. BS and MSAE. Experience not required but highly desirable, and will influence salary offer. Able to work in harmony with small research team, and get along well with citrus growers. Usual opportunity for advancement on demonstration of merit. Salary open. O-77-109

Agricultural Engineer (instructor) for teaching in power and machinery, in a western state college. Related advisory work with students, and on equipment program of college farm. Age 25-35. BSAE. Additional graduate work desirable. Farm background and college teaching or farm equipment operating and servicing experience desirable. Ability and interest in teaching. Agreeable personality. Cooperative. Initiative and enthusiasm to continue development of outstanding program. Salary $5,628 to $7,536 range to start, for academic year. O-79-110

Agricultural Engineer for research on cattle insect control equipment, with federal agency. Location Southwest. MS, PhD, or equivalent research experience. Able to work with scientists in other fields. Good working funds. Opportunity to use unlimited imagination and inventiveness in hypothesizing eradication methods and associated equipment. Promotion depends entirely on research accomplishments. Salary $6,435 to $10,635 to start, depending on training and research experience. O-71-111

Agricultural Engineer for research to improve methods and equipment for controlling or eradicating the cotton boll weevil. Federal agency. Location South. MS or PhD, or equivalent research experience. Able to work with scientists in other fields. New laboratory and good working funds. Opportunity to use unlimited imagination and inventiveness in developing eradication methods and associated equipment. Promotion depends entirely on research accomplishments. Salary $6,435 to $10,635 to start, depending on training and research experience. O-71-112

Agricultural Engineer for research on methods and equipment for controlling or eradicating corn and small grain insects. Federal agency. Location Southeast. MS or PhD, or equivalent research experience. Able to work with scientists in other fields. New laboratory and good working funds. Opportunity to use unlimited imagination and inventiveness in developing eradication methods and related equipment. Promotion depends entirely on research accomplishments. Salary $6,435 to $10,635 to start, depending on training and research experience. O-71-113

NEW POSITIONS WANTED

Agricultural Engineer for design, development, or research in materials handling, with manufacturer in Midwest. Married. Age 24. No disability. BSAE, 1958, Iowa State University. Farm background. Product design engineering with manufacturer, 2 yr. Military active duty completed. Available on reasonable notice. Salary open. W-66-9

Agricultural Engineer for design, development, research, extension, or teaching in farm structures or rural electric field, with manufacturer or public service, in Southeast. Single. Age 24. Vision corrected by glasses. BSAE, 1959, Virginia Polytechnic Institute. Farm background. Varied work experience before graduation. One year special training in heating and air conditioning. Army active duty to be completed in July. Available in July. Salary open. W-32-10

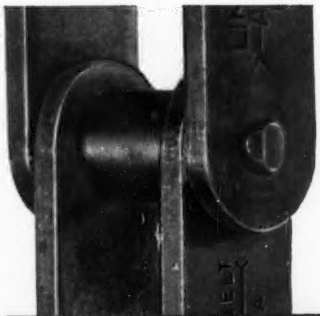
Agricultural Engineer for extension, teaching, or research in farm structures, with public service. Southwest or Midwest. Willing to travel. Single. Age 26. No disability. BSAE, 1957, University of Arkansas. Research and engineering with tractor manufacturer 15 months. Active commissioned service in Army Signal Corps, 2 years. Available on reasonable notice. Salary $450 per month. W-58-11

Agricultural Engineer for 3 months summer work with manufacturer of farm power equipment, anywhere in Continental U.S.A. Married. Age 45. Myopia corrected. BSAE, 1938, Oklahoma A & M College. MSAE, 1951, Kansas State College. Experience 8 years in ASC, including consultation on design, development and research. Teaching since 1946. Registered professional engineer in Arkansas. Available June 1. Salary open. W-56-12

Agricultural Engineer for design, development, research, sales, service, writing or management in rural electric or product processing field, with manufacturer, consultant or public service. Midwest. Limited travel. Married. Age 37. No disability. BSCE, University of Wisconsin. War non-commissioned service in USAF over 4 years. Agricultural sales engineer with electric utility 9 years. Partner in farmstead electrical equipment sales and service 4 years. Registered professional engineer in Illinois. Available on reasonable notice. Salary open. W-68-13

Agricultural Engineer for teaching, research or extension in power and machinery, farm structures, or electric power and processing with college, trade association or other industry activity. Full-time preferred but will consider part-time with graduate assistantship. Will travel. Married. Age 37. No disability. BSAE, 1949; MSAE, 1951, Michigan State University. With full line farm tractor and implement manufacturer 7 years in sales-training instruction, sales promotion, service, product testing, and general management. Application engineer 3 years with major diversified manufacturer. Instructor in agricultural engineering 2 years. Farm background. War service in U.S. Army. Available on reasonable notice. Salary open. W-75-14

Agricultural Engineer for sales, service, research or development in power and machinery or farm structures with industry or public service. Any location. Willing to travel. Married. Age 25. No disability. BSAE, 1958, Cornell University. Pre-graduation experience on dairy and general farms, SCS field unit, and USGS Surface Water Branch field office. Commissioned Naval service 3 years in engineering department as main engines officer on administration and maintenance of main propulsion plant on two large combatant ships. Available June 15. Salary open. W-96-15



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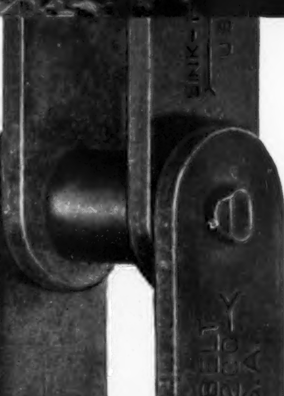

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Link-Belt offers industry's most complete line of drive and conveyor chains, conveyor chain attachments and sprockets. Also, "bonus" services: application counsel, field analysis, laboratory service and others. These services multiply the *value* of Link-Belt chains, *but not the price!* Contact your nearest Link-Belt office or the Indianapolis plant at 220 S. Belmont Street. Ask for 640-page Catalog 1050.

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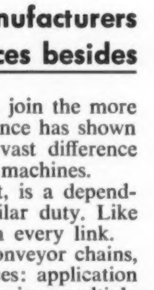

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